Sacramento Groundwater Authority Groundwater Management Plan

SGA

December 2003

GROUNDWATER MANAGEMENT PLAN

DECEMBER 2003

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Sacramento Groundwater Authority
Managing Groundwater Resources in Northern Sacramento County

December 11, 2003

Sacramento Groundwater Authority
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Members:
California-American Water Company
Carmichael Water District
Citrus Heights Water District
Del Paso Manor Water District
Fair Oaks Water District
Folsom, city of
Natomas Central Mutual Water Company
Orange Vale Water Company
Rio Linda/Elverta Community Water District
Sacramento, city of
Sacramento, county of
Sacramento Suburban Water District
San Juan Water District
Southern California Water Company
agricultural and self-supplied representatives

To Interested Parties and Individuals:

The Sacramento Groundwater Authority (SGA) is pleased to release this Groundwater Management Plan (GMP), adopted December 11, 2003. The plan represents a critical step in establishing a framework for maintaining a sustainable groundwater resource for the various users overlying the basin in Sacramento County north of the American River. It includes specific goals, objectives and an action plan to provide a "road map" for coordination among the 14 overlying water purveyors.

SGA and its members are committed to the regional objectives established by the historic Sacramento Water Forum Agreement, and these objectives are incorporated into the plan. Since SGA's formation in 1998, SGA members have taken many steps to preserve the valuable groundwater resources underlying our region. These activities and specific future actions are described in the GMP.

The plan is the product of several months of effort, with valuable input from technical and policy review committees as well as the public. SGA is grateful for the excellent input, technical assistance and funding provided through partnerships with the U.S. Army Corps of Engineers and the California Department of Water Resources.

This plan represents a starting point for basin management; it is intended to be adaptive. Comments and suggestions to improve our management efforts in the basin are welcome.

Sincerely,

Edward D. Winkler
Executive Director

RESOLUTION NO. 2003-07

A RESOLUTION OF THE SACRAMENTO GROUNDWATER AUTHORITY ADOPTING A GROUNDWATER MANAGEMENT PLAN AND A FINDING OF EXEMPTION FROM THE CALIFORNIA ENVIRONMENTAL QUALITY ACT

The Board of Directors of the Sacramento Groundwater Authority (SGA) does hereby find that:

WHEREAS, the SGA was formed under the Joint Exercise of Powers Act (Chapter 5 of Division 7 of Title 1 of the California Government Code) on August 11, 1998 by the Cities of Citrus Heights, Folsom, and Sacramento, and the County of Sacramento; and

WHEREAS, the SGA was created for the purposes of protecting, preserving, and enhancing, for current and future beneficial uses, the groundwater resources in the North Area Groundwater Basin, in Sacramento County, north of the American River; and

WHEREAS, the SGA has prepared a Groundwater Management Plan for the North Area Groundwater Basin; and

WHEREAS, the Groundwater Management Plan will further ongoing efforts to protect groundwater and interdependent environmental resources in the North Area Groundwater Basin, will facilitate collection of information to further understand and evaluate additional policies and programs for protection of the groundwater resources in the North Area Groundwater Basin, and will assist in other ongoing efforts to study the feasibility of conjunctive use programs utilizing the North Area Groundwater Basin.

NOW, THEREFORE, be it resolved that:

1. The SGA Board hereby adopts a Groundwater Management Plan for the North Area Groundwater Basin, in Sacramento County, north of the American River, copy attached hereto as Exhibit A.

2. The SGA Board further finds that the adoption of the Groundwater Management Plan is exempt from the requirements of the California Environmental Quality Act. (CEQA Guideline §§ 15061, 15306, 15307, 15308, and 15262).

PASSED AND ADOPTED by the Board of Directors of the Sacramento Groundwater Authority, on December 11, 2003.

By: _____
Chairperson, Sacramento Groundwater Authority

Attest: _____
Nancy Egger, Administrative Services Manager/Clerk

Acknowledgments

This Groundwater Management Plan (GMP) is a direct result of the commitment that Sacramento Groundwater Authority (SGA) members made to sustain the groundwater resource for present and future uses in northern Sacramento County. SGA would like to thank the staff of Montgomery Watson Harza in preparing the critical elements of this plan. Also of great value in preparing this plan was the insight generated by public outreach studies by Lucy & Company. Preparation of this GMP was generously supported by a funding partnership with the U.S. Army Corps of Engineers. Much of the data used to generate the information in this GMP was compiled using grant funds and a funding partnership with the California Department of Water Resources. Finally, SGA would like to thank the dedication of the Policy Committee and the Technical Review Committee in guiding the preparation of this plan. The names of the committee members and alternates are listed below:

Policy Committee

Ron Bachman, chair
Tom Barandas (alternate)
Jack DeWit
Tom Gray
Lyle Hoag (alternate)
Shauna Lorance
Gary Reents
Rob Roscoe (alternate)
Mike Winn

Technical Review Committee

Marshall Davert
Bill Dendy
Warren Jung (alternate)
Mary Keller
Ed Kriz
Shauna Lorance (alternate)
Bob Niblack (alternate)
Jim Peifer (alternate)
Toni Pezzetti
Rich Plecker
Rob Roscoe
Joe Scalmanini
John Woodling

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ABBREVIATIONS AND ACRONYMS

AB	Assembly Bill
Aerojet	Aerojet-General Corporation facility
AF	Acre-feet
AF/year	Acre-feet per year
AFRPA	Air Force Real Property Agency
ARBCUP	American River Basin Regional Conjunctive Use Program
ARWRI	American River Water Resources Investigation
BMO	Basin Management Objective
Cal-Am	California-American Water Company
CALFED	CALFED Bay-Delta Program
CAS	California Aquifer Susceptibility
cfs	Cubic feet per second
CHWD	Citrus Heights Water District
CMP	Sacramento Coordinated Water Quality Monitoring Program
COC	Contaminants of concern
Cooperating Agencies	American River Basin Cooperating Agencies
CSUS	California State University, Sacramento
CTP	Cooperative Transmission Pipeline
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWC	California Water Code
CWD	Carmichael Water District
DCA	1,2-dichloroethane
DCE	cis-1,2-dichloroethene
Delta	Sacramento/San Joaquin River Delta
DHS	California Department of Health Services
DPMWD	Del Paso Manor Water District
DMS	Data Management System
DWR	California Department of Water Resources
DWSAP Program	Drinking Water Source Assessment and Protection Program
EMD	Sacramento County Environmental Management Department
EWA	Environmental Water Account
Folsom	City of Folsom
FOWD	Fair Oaks Water District
GMP	Groundwater Management Plan
gpm	Gallons per minute
Groundwater Forum	Central Sacramento County Groundwater Forum
IGSM	North American River and Sacramento County Combined Integrated Groundwater and Surface Water Model
InSAR	Interferometric Synthetic Aperture Radar
ISI	Integrated Storage Investigation
JPA	Joint Powers Authority
Lincoln	City of Lincoln
LSCE	Luhdorff & Scalmanini Consulting Engineers

LUST	Leaking Underground Storage Tank
M&I	Municipal and industrial
Mather AFB	Mather Air Force Base
McClellan AFB	McClellan Air Force Base
MCL	Maximum Contaminant Level
MWH	Montgomery Watson Harza
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
mg/L	Millgrams per liter
mgd	Million gallons per day
msl	Mean sea level
NAWQA	National Water Quality Assessment
NCMWC	Natomas Central Mutual Water Company
NGS	National Geodetic Survey
NTP	Northridge Transmission Pipeline
OVWC	Orange Vale Water Company
PBE	Physical Barrier Effectiveness
PCAs	Potential Contaminating Activities
PCE	Tetrachloroethene
PCWA	Placer County Water Agency
PL	Public Law
POU	Place of Use
Reclamation	U.S. Bureau of Reclamation
RLECWD	Rio Linda/Elverta Community Water District
Roseville	City of Roseville
RWA	Regional Water Authority
RWMP	Regional Water Master Plan
Sac Regional	Sacramento Regional Wastewater Treatment Plant
Sac Suburban	Sacramento Suburban Water District
SACOG	Sacramento Area Council of Governments
Sacramento	City of Sacramento
SAFCA	Sacramento Area Flood Control Agency
SCWA	Sacramento County Water Agency
SCWC	Southern California Water Company
SGA	Sacramento Groundwater Authority
SJWD	San Juan Water District
SMWA	Sacramento Metropolitan Water Authority
SOP	Standard Operating Procedure
South Sutter	South Sutter Water District
SRCSD	Sacramento Regional County Sanitation District
SWRCB	State Water Resources Control Board
TCE	Trichloroethene
TDS	Total dissolved solids
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
Water Forum	Sacramento Area Water Forum
WEP	Water Efficiency Program

WFA	Water Forum Agreement
WTP	Water treatment plant

1 INTRODUCTION

The Sacramento Groundwater Authority (SGA) is a joint powers authority (JPA) created to manage the Sacramento region's North Area Groundwater Basin. The SGA's formation in 1998[1] resulted from a coordinated effort by the Sacramento Metropolitan Water Authority (SMWA) and the Sacramento Area Water Forum (Water Forum) to establish an appropriate management entity for the basin. The SGA is recognized as one of the essential tools to implement a comprehensive program to preserve the lower American River and ensure a reliable water supply through the year 2030.

The SGA draws its authority from a joint powers agreement[2] signed by the cities of Citrus Heights, Folsom, and Sacramento and the County of Sacramento to exercise their common police powers to manage the underlying groundwater basin. The agreement is included as **Appendix A** in this document. In turn, these agencies chose to manage the basin in a cooperative fashion by allowing representatives of the 14 local water purveyors and a representative from each agricultural and self-supplied pumpers to serve as the Board of Directors of the SGA[3].

At the core of the SGA's management responsibility is a commitment to not exceed the average annual sustainable yield of the basin, which was estimated to be 131,000 acre-feet[4] in the Water Forum Agreement (WFA)[5]. To accomplish this objective and to provide a safe, reliable water supply for the rapidly growing northern Sacramento County, this groundwater management plan (GMP) is necessary to begin to identify the many actions that should be taken in the North Area Groundwater Basin. This GMP represents a starting point from which the SGA will continually assess the status of the groundwater basin and make appropriate management decisions to ensure a sustainable resource. The SGA's boundary as well as the area covered by this GMP include only the portion of Sacramento County north of the American River (**Figure 1**). Continuing effort will be made to coordinate SGA's GMP activities with adjacent areas.

1.1 OTHER REGIONAL MANAGEMENT EFFORTS

Over the past several decades, the water supplies of the region have been impacted by:

- Prolonged drought and prolonged wet periods.
- Increasing pressure to dedicate surface water for environmental purposes.
- Declining groundwater levels.
- Impacts and growing threats to surface water quality and groundwater quality.

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1 The SGA was originally formed in 1998 as the Sacramento North Area Groundwater Management Authority. In 2002, it was renamed the Sacramento Groundwater Authority.

2 The agreement is included in this report as **Appendix A**.

3 SGA Board members include representatives of California-American Water Company, Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Sacramento, County of Sacramento, Del Paso Manor Water District, Fair Oaks Water District, Natomas Central Mutual Water Company, Orange Vale Water Company, Rio Linda/Elverta Community Water District, Sacramento Suburban Water District, San Juan Water District, Southern California Water Company, and individual representatives from agriculture and self-supplied groundwater users (principally parks and recreation districts).

4 This value was estimated based on water use and facilities in the basin at the time of the WFA. This value was based on a number of assumptions, and was not intended to be a fixed value that could not be modified as conditions and assumptions changed in the basin. Examples of changed conditions include new or improved water conveyance, treatment, and storage facilities or changes in water supply contracts.

5 The WFA is available online at http://www.waterforum.org or contact the Water Forum office at (916) 264-1999.

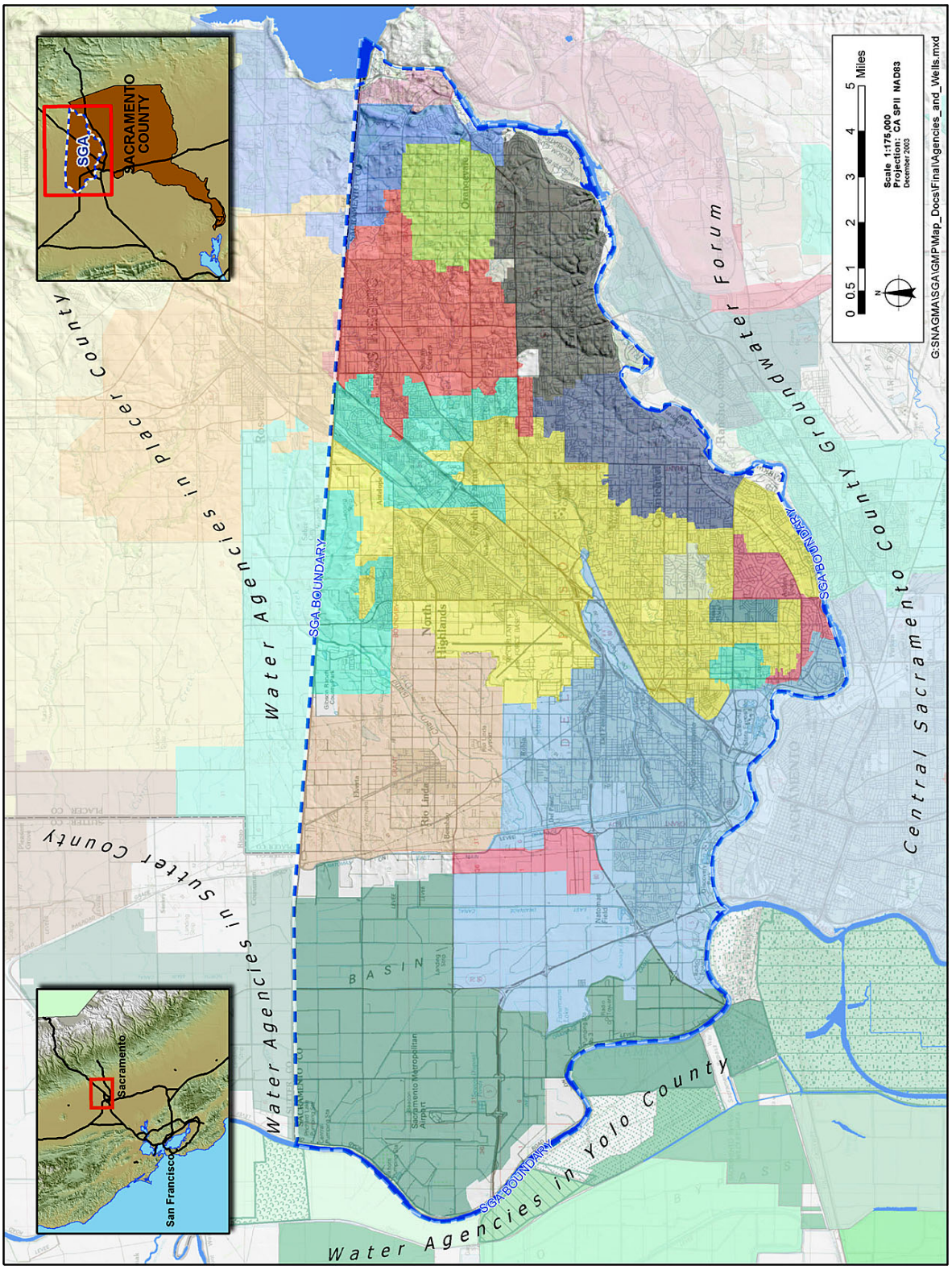


Figure 1. Boundary of the SGA and Area Covered by this Groundwater Management Plan

All the while, demand for water in the region has continued to grow.

To address these problems, water purveyors in the region have invested substantial time and resources in a progression of regional planning efforts. In particular, the planning efforts most directly related to the SGA's efforts include:

- The SMWA.
- The Water Forum process.
- The American River Basin Cooperating Agencies Regional Water Master Plan (Cooperating Agencies RWMP).
- The Regional Water Authority (RWA), successor to the SMWA.

Each of these regional planning efforts is discussed further below.

1.1.1 SMWA

Formed in 1990, the SMWA was a combined JPA and non-profit public benefit association of 17 public water suppliers within Sacramento County[6]. A primary objective of the SMWA was to facilitate actions needed to restore and maintain the quantity and the quality of the groundwater in the area. In support of that objective, the SMWA was a vital participant in the development of the WFA (see below). The SMWA also developed and adopted a GMP as authorized by Assembly Bill (AB) 3030 of 1992 (commonly referred to as AB 3030 Plans, see the California Water Code (CWC) § 10750 *et seq.*), but the plan was not fully implemented. In 2001, the SMWA was superceded by the RWA (see description below).

1.1.2 Water Forum

Begun in 1993, the Water Forum is a group comprised of business and agricultural leaders, citizens groups, environmentalists, water managers, and local governments in the Sacramento Region that joined together to fulfill two co-equal objectives:

- To provide a reliable and safe water supply for the region's economic health and planned development through the year 2030.
- To preserve the fishery, wildlife, recreational, and aesthetic values of the lower American River.

In 2000, Water Forum members approved the WFA, which consists of seven integrated actions necessary to accomplish these objectives. The WFA prescribes a local conjunctive use program for Folsom Reservoir, the lower American River, and the adjacent groundwater basin. One of the seven elements is groundwater management. This element divides Sacramento County groundwater basins into three subunits, the North, Central, and South areas, and recommends that the SGA (then known as the Sacramento North Area Groundwater Management Authority) serve as the governing body for the North Area Groundwater Basin. The groundwater element also estimated and recommended an average annual sustainable groundwater yield for the SGA

[6] The SMWA members were located both north and south of the American River and included (note that some purveyor names have been changed and/or undergone consolidation since the formation of the SMWA): City of Folsom, City of Galt, Arden Cordova Water Service Company, Arcade Water District, Carmichael Water District, Citrus Heights Water District, Clay Water District, Del Paso Manor Water District, Elk Grove Water Works, Fair Oaks Water District, Galt Irrigation District, Northridge Water District, Omochumne-Hartnell Water District, Orange Vale Water Company, Rancho Murieta Community Services District, Rio Linda/Elverta Community Water District, and San Juan Water District.

area of 131,000 acre-feet per year (AF/year) (roughly equivalent to the 1990 groundwater pumping rate within the North Area Groundwater Basin). The Water Forum continues to function with a dedicated staff in the Water Forum Successor Effort program to coordinate with other agencies and groups, such as the SGA, to ensure that the elements of the WFA are carried out.

1.1.3 Cooperating Agencies

The Cooperating Agencies are an ad-hoc group of local water purveyors in northern Sacramento County and southern Placer County[7]. Each of the Cooperating Agencies is a signatory of the WFA. The Cooperating Agencies were formed to complete a RWMP, the objective of which is to identify the facilities and operational agreements necessary to implement the WFA for the northern Sacramento/Placer area. This plan will result in identifying opportunities to improve the availability of water supplies through additional conjunctive use of surface water and groundwater in the region. These expanded conjunctive use opportunities are a key component to assuring a sustainable groundwater resource within the SGA's area. Upon completion of the RWMP, the Cooperating Agencies have sunset as an organization with much of their function assumed by the RWA.

1.1.4 RWA

The RWA succeeded the SMWA in 2001 through a JPA to serve and represent the regional water supply interests, and assist members in protecting and enhancing the reliability, availability, affordability, and quality of water resources. One of the principal missions of the RWA is facilitating implementation of the conjunctive use program prescribed by the WFA and the RWMP. The RWA currently has eighteen members and three associate members[8] including each of the Cooperating Agencies except the Sacramento County Water Agency (SCWA). Nearly all members are signatory to the WFA.

As with the Cooperating Agencies, the success of implementing additional conjunctive use opportunities will be an important factor in the SGA's ability to ensure a reliable groundwater supply within its area. The activities of the RWA and SGA are highly coordinated as they share a common office and staff.

1.1.5 Other Ongoing Groundwater Management-Related Activities within the SGA Area

In addition to the on-going programs by individual SGA members, there are several other on-going groundwater-related activities within the SGA area. Coordination between these efforts

[7] The "Cooperating Agencies" include water purveyors in both Sacramento County and Placer County: California-American Water Company, Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Roseville, City of Sacramento, Del Paso Manor Water District, Fair Oaks Water District, Placer County Water Agency, Rio Linda/Elverta Community Water District, Sacramento County Water Agency, Sacramento Suburban Water District, and San Juan Water District.

[8] The membership of the RWA encompasses water users in both Sacramento County and Placer County including: California-American Water Company, Carmichael Water District, Citrus Heights Water District, City of Folsom, City of Lincoln, City of Roseville, City of Sacramento, Del Paso Manor Water District, El Dorado Irrigation District, Fair Oaks Water District, Fruitridge Vista Water Company, Orange Vale Water Company, Placer County Water Agency, Rancho Murieta Community Services District, Rio Linda/Elverta Community Water District, Sacramento Suburban Water District, San Juan Water District, and the Southern California Water Company. Associate members do not directly retail drinking water and do not vote in RWA matters. Associate members include: El Dorado County Water Agency, Sacramento Municipal Utility District, and Sacramento Regional County Sanitation District.

and the SGA will be discussed in more detail later in this GMP. The activities closely related to the SGA's groundwater management efforts include, but are not limited to, the following:

- Groundwater contamination investigation and remediation activities at the former McClellan Air Force Base (McClellan AFB).
- Groundwater contamination investigation and remediation activities at the Aerojet-General Corporation facility (Aerojet).
- Monitoring of groundwater levels and quality by the California Department of Water Resources (DWR).
- Monitoring of groundwater levels and quality at California State University, Sacramento (CSUS).
- Monitoring of groundwater quality by the U.S. Geological Survey (USGS) as part of its National Water Quality Assessment (NAWQA) Program.
- Monitoring of site investigations and remediation efforts at known leaking underground storage tanks (LUSTs) coordinated by the Central Valley Regional Water Quality Control Board (CVRWQCB).
- In the mid-1990s, DWR conducted a study on the feasibility of conjunctive use in northwest Sacramento County and western Placer County (DWR, 1997). Natomas Central Mutual Water Company (NCMWC), an SGA member, was a cooperating agency to the study. Two multi-depth monitoring wells were constructed in the northwest Sacramento County as a result of the study and are currently monitored by DWR.

1.2 PURPOSE OF THE SGA GMP

The groundwater management goal of the SGA is to maintain a sustainable, high-quality groundwater resource for the users of groundwater basin underlying Sacramento County north of the American River consistent with the objectives of the WFA. To meet that goal, the purpose of this GMP is to serve as the initial framework for coordinating the many independent management activities into a cohesive set of management objectives and related actions necessary to meet those objectives.

1.3 AUTHORITY TO PREPARE AND IMPLEMENT A GMP

The authority of the SGA to manage the North Area Groundwater Basin is provided through the joint powers agreement. The SGA Board of Directors elected to prepare this GMP as one of the tools necessary to effectively manage the basin. The SGA is preparing this GMP consistent with the provisions of CWC § 10750 *et seq.* as amended January 1, 2003.

1.4 GMP COMPONENTS

The SGA GMP includes the following required and recommended components:

- CWC § 10750 *et seq.* (seven mandatory components). Recent amendments to the CWC § 10750 *et seq.* require GMPs to include several components to be eligible for the award of funds administered by DWR for the construction of groundwater projects or groundwater quality projects[9].
- DWR Bulletin 118 (2003) components (seven recommended components).

[9] These amendments to the CWC were included in Senate Bill 1938, effective January 1, 2003.

- CWC § 10750 *et seq.* (12 voluntary components). CWC § 10750 *et seq.* includes 12 specific technical issues that could be addressed in GMPs to manage the basin optimally and protect against adverse conditions.

Table 1 lists the section(s) in which each component is addressed.

Table 1. Location of SGA GMP Components

Description	Section(s)
A. CWC § 10750 *et seq.*, Mandatory Components	
1. Documentation of public involvement statement.	3.4.1, 6.3
2. Basin Management Objectives (BMOs).	3.2
3. Monitoring and management of groundwater elevations, groundwater quality, inelastic land surface subsidence, and changes in surface water flows and quality that directly affect groundwater levels or quality or are caused by pumping.	3.5
4. Plan to involve other agencies located within groundwater basin.	3.4.2
5. Adoption of monitoring protocols by basin stakeholders.	3.5, 6.4
6. Map of groundwater basin showing area of agency subject to GMP, other local agency boundaries, and groundwater basin boundary as defined in DWR Bulletin 118.	**Figure 2**
7. For agencies not overlying groundwater basins, prepare GMP using appropriate geologic and hydrogeologic principles.	N/A
B. DWR's Suggested Components	
1. Manage with guidance of advisory committee.	3.4.3
2. Describe area to be managed under GMP.	2.1 – 2.5
3. Create link between BMOs and goals and actions of GMP.	**Figure 10**
4. Describe GMP monitoring program.	3.5, **Figure 12, Figure 13**
5. Describe integrated water management planning efforts.	3.8
6. Report on implementation of GMP.	4.1
7. Evaluate GMP periodically.	4.2
C. CWC § 10750 *et seq.*, Voluntary Components	
1. Control of saline water intrusion.	3.6.6
2. Identification and management of wellhead protection areas and recharge areas.	3.6.3, 3.6.4
3. Regulation of the migration of contaminated groundwater.	3.6.5
4. Administration of well abandonment and well destruction program.	3.6.2
5. Mitigation of conditions of overdraft.	3.7
6. Replenishment of groundwater extracted by water producers.	3.7
7. Monitoring of groundwater levels and storage.	3.5
8. Facilitating conjunctive use operations.	3.7
9. Identification of well construction policies.	3.6.1
10. Construction and operation by local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.	3.6.5, 3.7
11. Development of relationships with state and federal regulatory agencies.	3.4.4
12. Review of land use plans and coordination with land use planning agencies to assess activities that create reasonable risk of groundwater contamination.	3.8.1, 6.5

2 WATER RESOURCES SETTING

Locations of water purveyors within the SGA boundaries are shown in **Figure 1**. Within the SGA boundaries, water purveyors currently utilize both surface water and groundwater. Some rely exclusively on either groundwater or surface water to meet their needs; others use a combination of surface water and groundwater. The groundwater and surface water supplies available to the region are summarized below.

2.1 GROUNDWATER SUPPLIES

This section provides a regional description of the geologic and hydrogeologic conditions of the underlying groundwater basin. A map showing the area of the groundwater basin, as defined by DWR Bulletin 118 (2003), and the SGA boundaries within this basin is presented in **Figure 2**.

The North American Subbasin is defined by DWR as the area bounded on the west by the Feather and Sacramento rivers, on the north by the Bear River, on the south by the American River, and on the east by the Sierra Nevada (DWR, 2003). DWR Bulletin 118 (2003) provides additional information about the North American Subbasin on the agency's Web site[10] including:

- Surface Area: 548 square miles.
- The eastern basin boundary is a north-south line extending from the Bear River south to Folsom Reservoir. This represents the approximate edge of the alluvial basin where little or no groundwater flows into or out of the groundwater basin from the Sierra Nevada.
- The western portion of the subbasin consists of nearly flat flood basin deposits from the Bear, Feather, Sacramento and American rivers, and several small east side tributaries

The SGA area is located in the southern portion of the North American Subbasin extending as far north as the Sacramento-Placer County line. Regional and grouped data are provided in this section; water purveyor-specific data are presented in **Appendix B.**

2.1.1 Overview of Hydrogeologic Setting

The groundwater resources of Sacramento County have been extensively investigated and reported in the DWR Bulletin 118-3, Evaluation of Ground Water Resources: Sacramento County (July, 1974).

2.1.1.1 Hydrostratigraphy of SGA Area

DWR Bulletin 118-3 identifies and describes the various geologic formations that constitute the water-bearing deposits underlying Sacramento County. These formations include an upper, unconfined aquifer system consisting of the Victor, Fair Oaks, and Laguna Formations, and a lower, semi-confined aquifer system consisting primarily of the Mehrten Formation. These formations are shown on **Figure 3** and are typically composed of lenses of inter-bedded sand, silt, and clay, interlaced with coarse-grained stream channel deposits. **Figure 3** illustrates that these deposits form a wedge that generally thickens from east to west to a maximum thickness of about 2,000 feet under the Sacramento River.

[10] At: http://www.dpla2.water.ca.gov/publications/groundwater/bulletin118/basins/5-21.64_North_American.pdf.

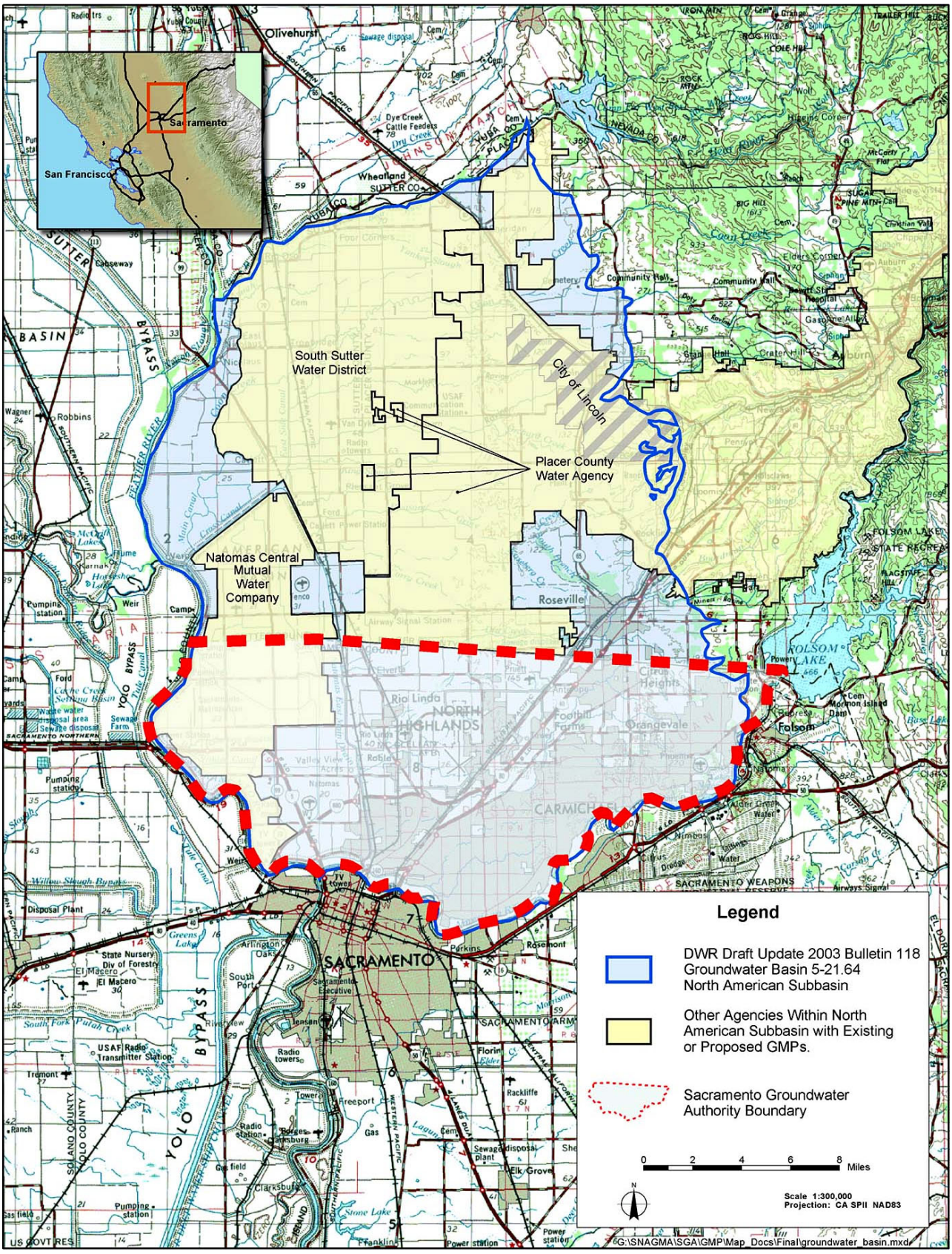


Figure 2. Location of North American Groundwater Subbasin

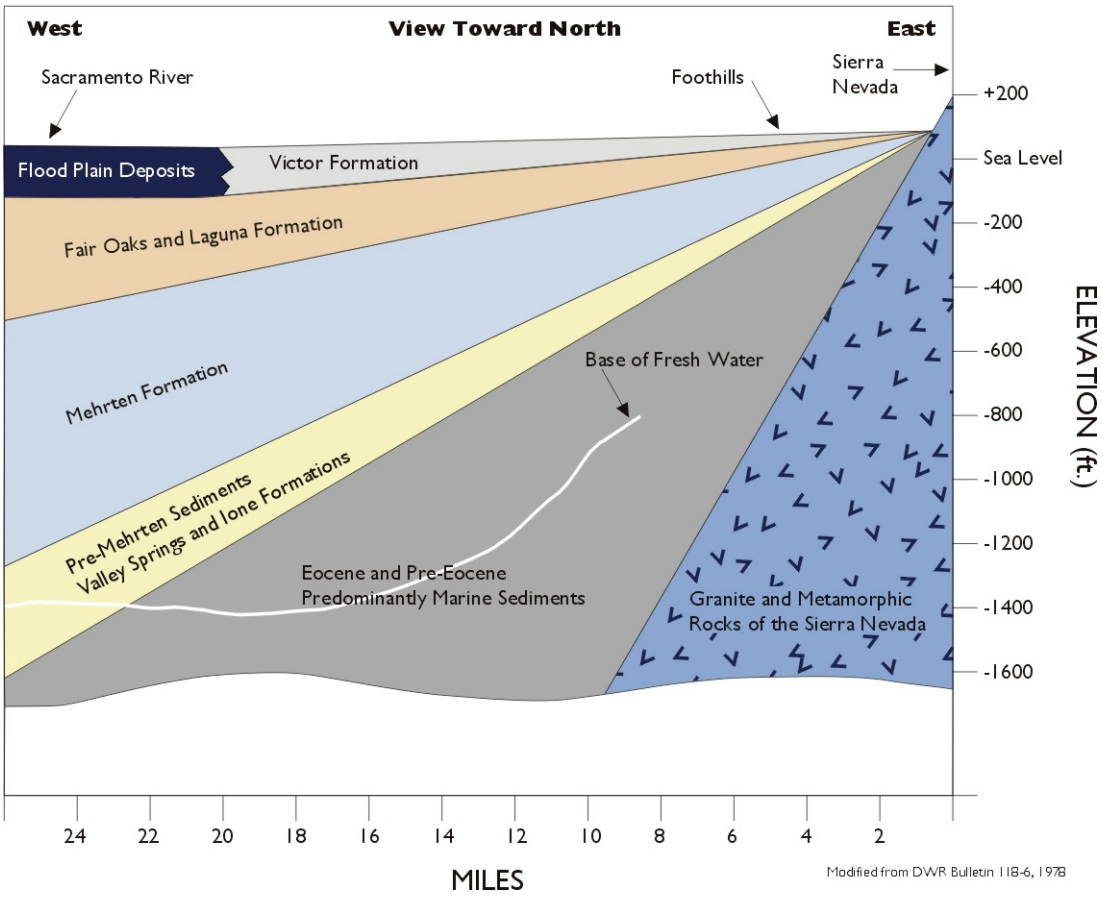


Figure 3. Regional Stratigraphic Column

Groundwater occurs in unconfined to semi-confined states throughout the North American Subbasin. Semi-confined conditions occur in localized areas; the degree of confinement typically increases with depth below the ground surface. Groundwater in the Victor, Fair Oaks, and Laguna Formations (upper aquifer) is typically unconfined. However, due to the heterogeneous nature of the alluvial depositional system, semi-confined conditions can be encountered at shallow depths in the aquifer. The deeper Mehrten Formation (lower aquifer) typically exhibits semi-confined conditions. There are no regionally-extensive fine grained layers in the subsurface to create a regionally confined aquifer such as is observed in the San Joaquin Valley from the Corcoran Clay layer.

2.1.1.2 Groundwater Quality

The water quality in the upper aquifer system is regarded as superior to that of the lower aquifer system. The upper aquifer is preferred over the lower aquifer principally because the lower aquifer system (specifically the Mehrten formation) contains higher concentrations of iron and manganese. Water from the upper aquifer generally does not require treatment (other than disinfection). The lower aquifer system also has higher concentrations of total dissolved solids (TDS, a measure of salinity) than the upper aquifer, although it typically meets standards as a potable water supply. In general, at depths of approximately 1,200 feet or greater (actual depth varies throughout the basin), the TDS concentration exceeds 2,000 milligrams per liter (mg/L). At such concentrations, the groundwater is considered non-potable without treatment.

Background Water Quality. This description of background water quality is based on data used to populate the Data Management System (DMS). Available groundwater quality data from monitoring between 1991 and 2002 for 260 wells were used to populate the DMS. The DMS was used to query data and develop statistics and graphics for the constituents included in this evaluation. Evaluations were performed for constituents of primary concern related to aesthetics, regulatory impacts, and contaminant plumes, and constituents of future concern related to aesthetics and regulatory concerns.

Total Dissolved Solids. TDS results in most wells are within the secondary drinking water standard; therefore, TDS will not limit the potable use of groundwater by the overlying agencies. The TDS levels vary quite significantly throughout the SGA portion of the basin, ranging from 34 to 657 mg/L, although most wells have levels between 140 and 320 mg/L.

Iron and Manganese. Iron and manganese results for most wells are within the secondary drinking water standards; therefore, iron and manganese will not limit the potable use of groundwater by the overlying agencies. Iron can range from non-detect, less than 10 micrograms per liter (μg/L), to very high levels such as 16,000 μg/L, although most wells have average values less than 200 μg/L. Manganese concentrations range from non-detectable, less than 2 μg/L, to 1,700 μg/L, although most wells have average values less than 50 μg/L.

Arsenic and Chromium. Arsenic and chromium results for most wells are within the current primary drinking water standards; therefore, arsenic and chromium will not limit the potable use of groundwater by the overlying agencies. Currently, there is a primary federal Maximum Contaminant Level (MCL) for arsenic of 10 μg/L, however compliance is not yet required in California below 50 μg/L. Arsenic concentrations range from non-detectable, less than 1 μg/L, to 22 μg/L, although most wells have average values less than 5 μg/L.

Currently, total chromium has a primary MCL of 50 μg/L. Chromium concentrations range from non-detectable, less than 1 μg/L, to 52 μg/L, although most wells range between 8 and 12 μg/L.

Nitrate. It appears that all wells are within the current primary nitrate drinking water standard and nitrate will not limit the potable use of groundwater by the overlying agencies. Currently, nitrate has a primary MCL of 45 mg/L. Most SGA wells have low levels (< 15 μg/L) of nitrate.

Known "Principal" Plumes. Principal groundwater contaminant plumes within or near the SGA area are known to exist from source areas at the former McClellan AFB, the former Mather Air Force Base (Mather AFB), and Aerojet and are shown on **Figure 4**. During Phase II development of the DMS, contaminant plume data were collected by SGA from the following documents:

- URS. Former McClellan Air Force Base, Installation Restoration Program, Groundwater Monitoring Program: Quarterly Report, Third Quarter 2002. January 2003.
- Montgomery Watson Harza (MWH). Mather Air Force Base Annual and Fourth Quarter 2002 Sitewide Groundwater Monitoring Report. March 2003.
- Aerojet Environmental Remediation. Aerojet Sacramento Site, American River Study Area Groundwater Monitoring Results, April – June 2002. August 2002.

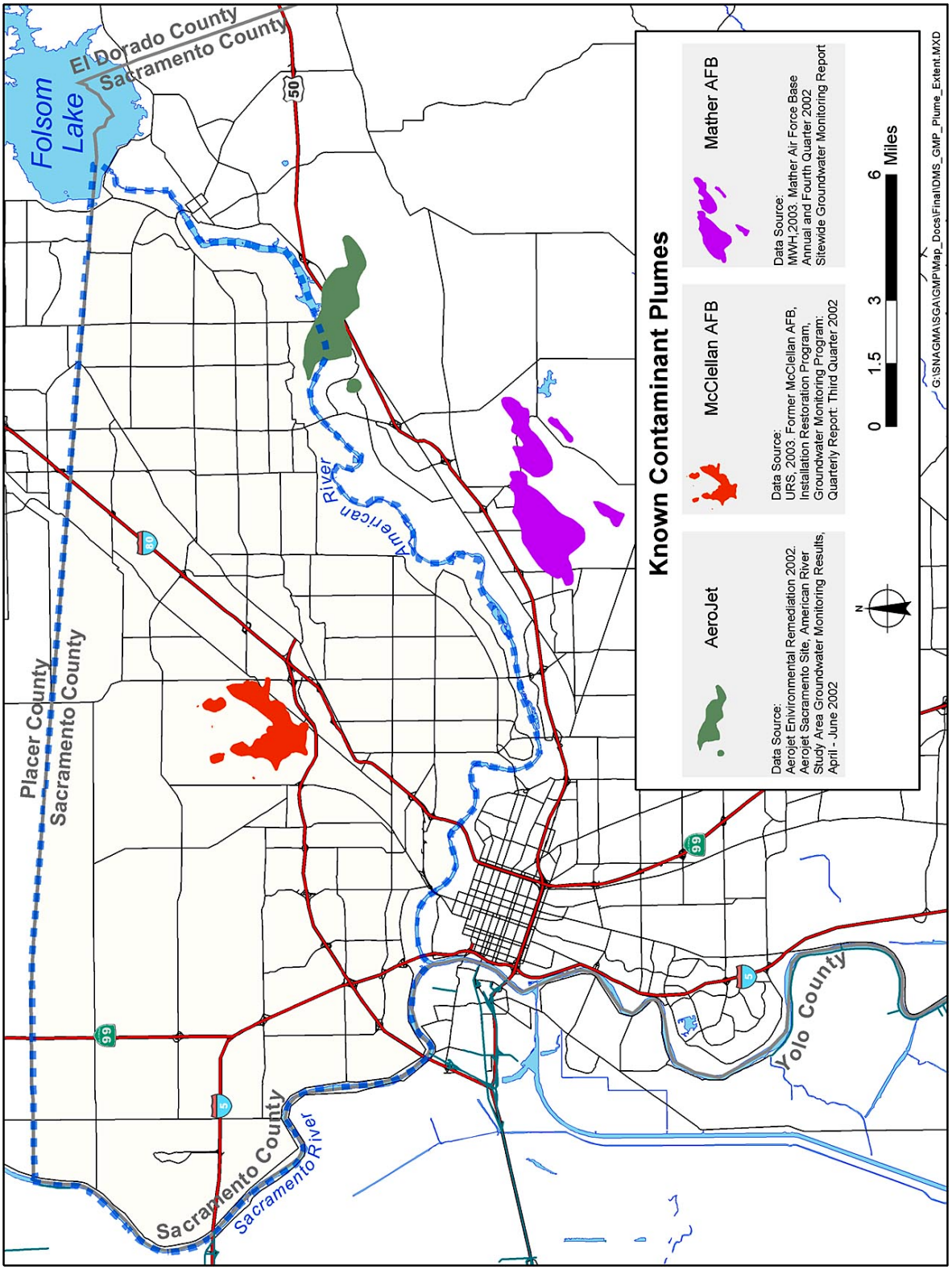


Figure 4. Principal Contaminant Plumes

Although other localized plumes exist within the SGA area, the principal plumes shown in **Figure 4** are the largest and have the greatest current impact on existing groundwater use. For the McClellan AFB plumes, the primary contaminants of concern (COC) are trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene (DCE), and 1,2-dichloroethane (DCA). The McClellan AFB plume edges represent the California drinking water MCL of 5 µg/L TCE, the most extensive contaminant.

For the Mather AFB plumes, the primary COCs are TCE, PCE, and carbon tetrachloride. The Mather AFB plume edges represent a composite COC concentration of 0.5 µg/L, which is one-tenth of the MCL for these constituents.

For the Aerojet plume, the primary COCs are TCE and perchlorate. The Aerojet plume edges represent a concentration of 5 µg/L TCE, the most extensive contaminant.

There are currently about 190 active LUST sites within the SGA area (source: http://geotracker.swrcb.ca.gov). While many sites can be fully remediated, the aggregate impact from undetected contamination on groundwater quality in the basin cannot be determined at this time and may ultimately be considerable.

2.1.1.3 Recharge and Extraction of Groundwater in Sacramento County

Evaluating changes in aquifer conditions requires understanding the dynamic processes and interactions taking place as extractions and recharge in the aquifer occur. Conceptual models of the aquifer that describe induced recharge, aquifer storage, and differences between localized and regional effects on the aquifer are discussed below. These conceptual models are meant to clarify concepts; not all aspects of groundwater hydraulics are described. Some of the concepts presented pertain only to the northern Sacramento County aquifers.

Recharge. Groundwater in northern Sacramento County moves from sources of recharge to areas of discharge. Recharge to the local aquifer system occurs along active river and stream channels where extensive sand and gravel deposits exist, particularly in American River and Sacramento River channels. Prior to development of the area, additional recharge would have occurred along the eastern boundary of the SGA area at the transition point from consolidated rocks of the Sierra Nevada to the alluvial deposited basin sediments. Other sources of recharge within the area include inflow of groundwater generally from the northeast; subsurface recharge from fractured geologic formations to the east; and deep percolation from applied surface water, precipitation, and small streams. An example of recharge from deep percolation can be seen in the western SGA area where extensive agricultural operations in NCMWC have redistributed surface water from the Sacramento River over a much broader area. Some of the water not used by the crops grown in the area will eventually act as a source of recharge to the groundwater basin.

Changes in the groundwater surface elevation result from changes in groundwater recharge, discharge, or extraction. In some instances within northern Sacramento County, this change in groundwater elevation can induce natural recharge at locations where rivers or streams and the aquifer are hydraulically connected. To the extent that a hydraulic connection exists, as groundwater conditions change, the slope or gradient of the groundwater surface may change as well. A steeper gradient away from the stream would induce higher recharge from surface water into the aquifer.

The rate of recharge from streams that are hydraulically disconnected from the groundwater surface is indifferent to changes in groundwater elevations or gradient. This is typically true with smaller streams where the groundwater surface is located far below the streambed. In such cases, surface water percolates through the unsaturated zone to the groundwater and is a function of the aquifer materials underlying the streambed and the water level in the surface stream. The rate of infiltration under these conditions is not controlled by the change in elevation of the underlying groundwater. There is also some evidence to suggest these conditions exist along the Sacramento River in northern Sacramento County.

Localized Impacts of Groundwater Extraction. When extractions occur from a single well, a concentrated localized cone of depression is formed around the well. The shape and depth of the localized cone of depression depend on several factors including (but not limited to): (1) the rate of extraction, (2) the presence of nearby sources of recharge and extraction, (3) aquifer transmissivity, and (4) the "confined" or "unconfined" state of the aquifer, (i.e., storage coefficient). Over a period of time, extraction from an unconfined aquifer can de-water the aquifer around the well. However, when extraction ceases, the water level within the aquifer typically rebounds to its pre-extraction condition.

A confined or semi-confined aquifer behaves differently since the water is under pressure from a recharge source. Instead of de-watering the aquifer, a change in confining pressure occurs as a result of extractions; the aquifer remains saturated. In a confined aquifer, the pressure or piezometric surface elevation decline is more dramatic than in an unconfined aquifer; however, the recovery to pre-extraction conditions is typically much faster.

Regional Impacts of Groundwater Extraction. Large regional cones of depression can form in areas where multiple groundwater extraction wells are in operation. The location and shape of a regional cone of depression is influenced by the same factors as a single well. The regional cone of depression within the SGA area is shown on **Figure 5,** a water elevation contour map for spring of 2002. This map was prepared using water elevation data from DWR's water data library available on-line at: http://wdl.water.ca.gov. The Inverse Distance to a Power gridding method was used to contour the water elevation data posted on **Figure 5**. This contouring method is a weighted average interpolator and is best used when there is a uniform distribution of data. With Inverse Distance to a Power, data are weighted during interpolation such that the influence of one point relative to another declines with distance from the grid node. Normally, Inverse Distance to a Power behaves as an exact interpolator. When calculating a grid node, the weights assigned to the data points are fractions, and the sum of all the weights are equal to 1.0.

Fluctuations in regional cones of depression are measured over years and result from: (1) changes in recharge, and (2) changes in extractions from increasing and decreasing water demands. A sequence of successive dry years can decrease the amount of natural recharge to the aquifer and often a coinciding increase in groundwater extraction, creating an imbalance between natural recharge and extractions. Consequently, groundwater elevations decrease in response to this imbalance between recharge and extraction. Over time, the shape and location of the aquifer's regional cone of depression fluctuates.

Intensive use of the groundwater basin has resulted in a general lowering of groundwater elevations near the center of the basin away from the sources of recharge. As early as 1968, pumping depressions were evident in northern Sacramento County. These depressions have grown and coalesced into a single cone of depression centered in the SGA area as shown in **Figure 5**.

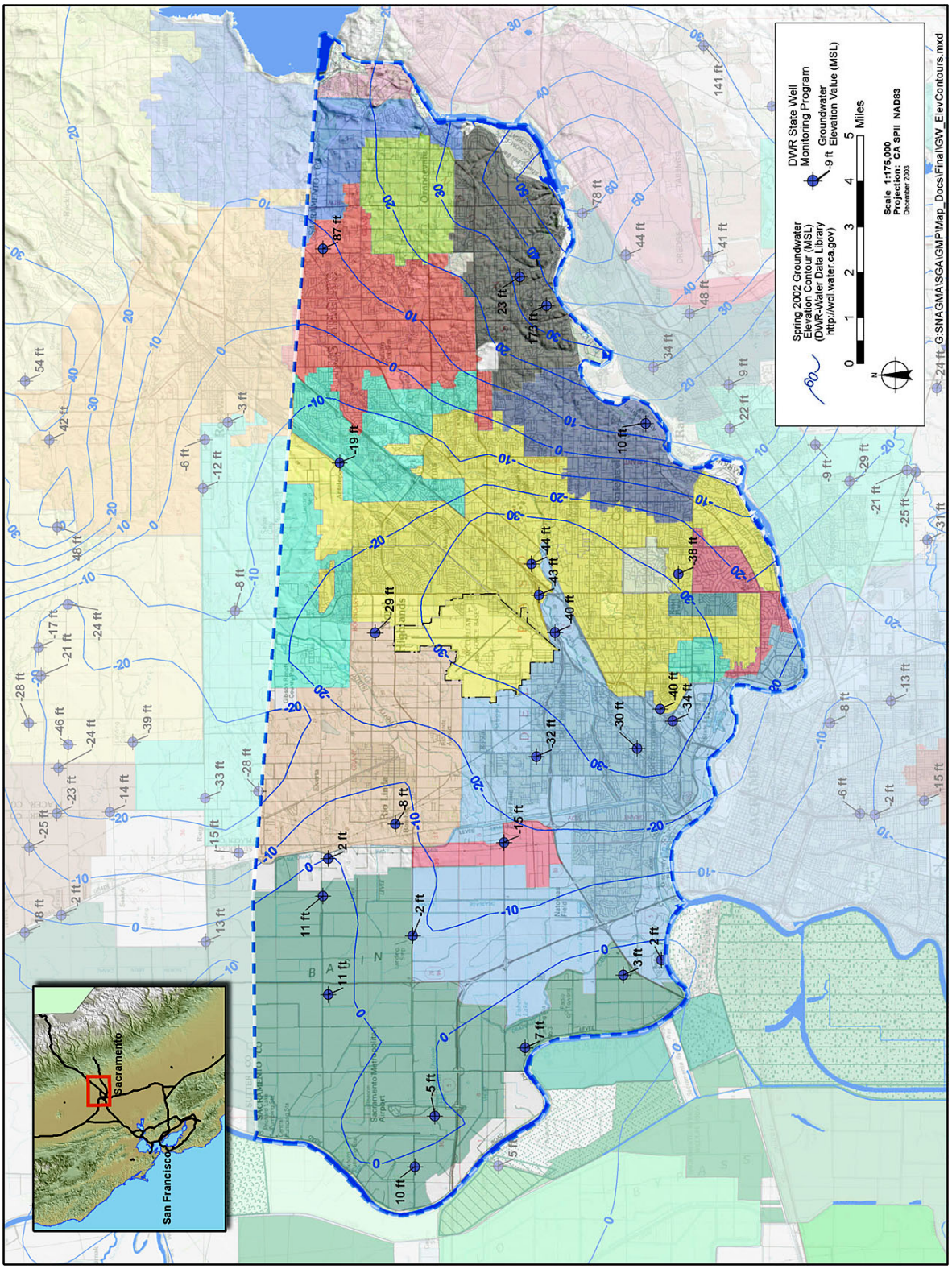


Figure 5. Spring 2002 Groundwater Elevation Contours

Groundwater Level Trends. To observe characteristic trends in groundwater elevation, selected well hydrographs have been prepared and are presented on **Figure 6.** For the purpose of this discussion, the SGA area has been divided into four sub-areas.

Western Area. The western portion of the SGA area is bounded by the Sacramento River and is relatively undeveloped compared to the rest of the SGA area. Groundwater level trends in this area can be seen in hydrographs from SWP-216 (located near the Sacramento River), and SWP-216 (also located near the Sacramento River) shown on **Figure 6**. The hydrographs for these wells show groundwater levels varying between -5 and 20 feet above mean sea level (msl) between wells. Long-term trends of increasing or decreasing groundwater levels are not evident in these wells, however, groundwater levels do fluctuate seasonally in each well.

North-Central Area. The north-central portion of the SGA area is bounded by the county line on the north. Water in the north-central portion of the SGA area is supplied entirely by groundwater sources. Furthermore, pumping of groundwater occurs at treatment extraction wells being operated at McClellan AFB, which is located in the center of this region of the SGA area. The general trend in this area is steeply declining groundwater levels until the early 1990s and then stabilized levels. For example, SWP-276 (**Figure 6**) shows a decline of about 17 feet per decade from 1950 to 1990 and then stabilization of groundwater elevation at approximately 40 feet below msl to the end of the record in 1996. Water level trends in SWP-270 show the same decline from 1955 to 1990 followed by stabilized levels (with seasonal fluctuation) at 40 feet below msl from 1990 to the present.

South-Central Area. The south-central portion of the SGA area is bordered to the south by the American River and is supplied by approximately even proportions of surface water and groundwater. The general trend in this area is gently to moderately declining groundwater levels over time **(Figure 6)**. Water level trends in this area can be seen in hydrographs from wells SWP-220 (located south of McClellan AFB away from the American River), SWP-232 (located near the river), and SWP-240 (located near the river). The hydrograph SWP-232 shows approximately 20 feet of groundwater elevation decrease over a 34-year period ending 2002.

Eastern Area. Foothills bound the eastern portion of the SGA area. The eastern portion of the SGA area has experienced rapid residential growth in recent years and extends into the Sierra Nevada foothills. The water supply in this area is approximately 80 percent from surface water sources and 20 percent from groundwater sources. The general trend in this area is stable groundwater elevations near the American River and high elevations in the foothills, with declining groundwater levels away from the river and foothills. Water level trends in this area can be seen in hydrographs from wells SWP-236 (located near the River) and SWP-283 (located high in the foothills). The hydrographs for these wells show stable groundwater levels near the river and in the foothills.

2.2 SURFACE WATER SUPPLIES

Individual water purveyors utilize both surface water and groundwater. The supply mix may include combinations of groundwater; American River water diverted pursuant to water rights, contract entitlements, or other agreements; or Sacramento River water diverted pursuant to water rights or contract entitlements. This section describes surface water supplies available to the water purveyors within the SGA. Regional and grouped data are provided in this section; water purveyor-specific data are presented in **Appendix B.**

2.2.1 Water Rights/Contract Entitlements

2.2.1.1 American River Water Rights

Four of the water purveyors within the SGA boundaries have water rights on the American River: Carmichael Water District (CWD), City of Folsom (Folsom), City of Sacramento (Sacramento), and San Juan Water District (SJWD).

The place of use (POU) for CWD's water right is coincident with the boundaries of the District.

The POU for Folsom's water right is coincident with the city limits and portions of the lands owned by Aerojet.

The POU for Sacramento's water rights on the American River extends beyond the boundaries of the city limits. The authorized POU outside the city limits includes (1) portions of California-American Water Company (Cal-Am), Arden service area; (2) Del Paso Manor Water District (DPMWD); (3) Sacramento Suburban Water District (Sac Suburban), Arcade service area (Town and Country subarea) and portions of Northridge service area; (4) SCWA, Arden Park Vista service area; (5) Southern California Water Company (SCWC), Arden Town service area; and (6) portions of CWD. In addition, a portion of Sacramento's American River POU overlaps with the place of use for the Sacramento River water rights and contract entitlements of NCMWC.

The POU for SJWD's water rights is the District's wholesale service area which encompasses SJWD retail service areas in Sacramento and Placer Counties, Citrus Heights Water District (CHWD), Fair Oaks Water District (FOWD), Orange Vale Water Company (OVWC), and that portion of Folsom that lies north of the American River.

2.2.1.2 American River Contract Entitlements

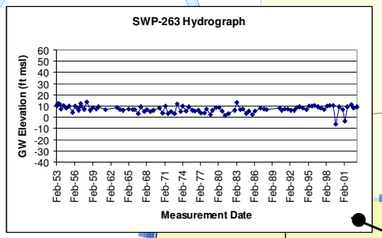
In Sacramento County, two water purveyors have existing water supply contract entitlements with the U.S. Bureau of Reclamation (Reclamation) Central Valley Project (CVP): Folsom and SJWD. SJWD provides CVP water to agencies within its wholesale service area.

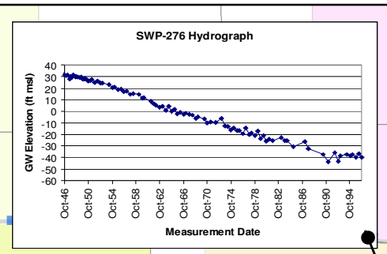
In addition, SJWD and SCWA executed a water supply contract entitlement with Reclamation from Public Law (PL) 101-514 (commonly referred to as "Fazio Water") in 1999. However, the contract is currently being renegotiated under the CVP long-term contract renewals. SJWD's contract entitlement is for 13,000 AF/year, and this supply is used within SJWD's Sacramento County wholesale area. SCWA's contract entitlement is for 22,000 AF/year, and this supply is used within Zone 40 (south of the American River). Folsom has a subcontract with SCWA for 7,000 AF/year (out of the potentially available 22,000 AF/year).

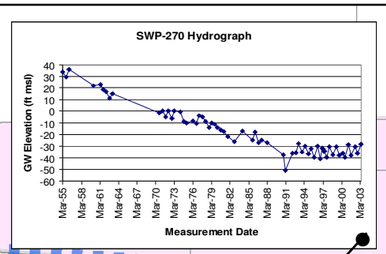
Sac Suburban has a water sale agreement with Placer County Water Agency (PCWA). The POU for this water includes Sac Suburban's Northridge service area and Arcade service area (North Highlands subarea only) and the service areas of SJWD, FOWD, OVWC, CHWD, the former McClellan AFB, Cal-Am (Antelope and Lincoln Oaks\Royal Oaks service areas), and Rio Linda/Elverta Community Water District (RLECWD).

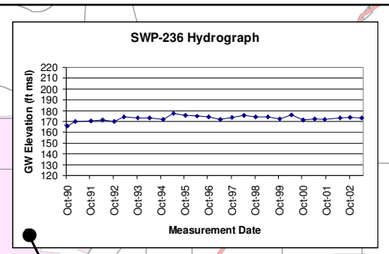
2.2.1.3 Sacramento River Water Rights

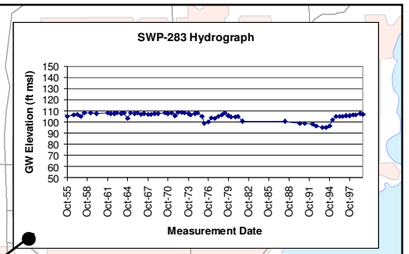
Two of the water purveyors within the SGA boundaries have water rights on the Sacramento River: Sacramento and NCMWC. The POU for NCMWC's water rights on the Sacramento River is the water company service area that includes both the Sacramento County and Sutter County areas. The POU for Sacramento's water rights on the Sacramento River is the city limits.

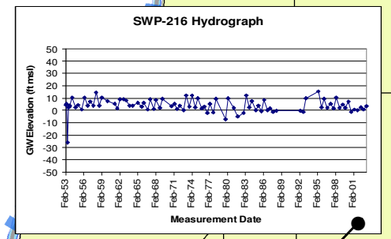


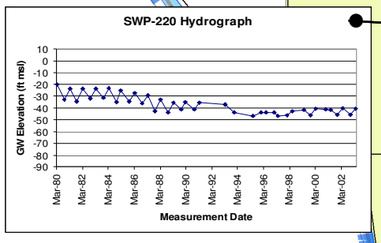


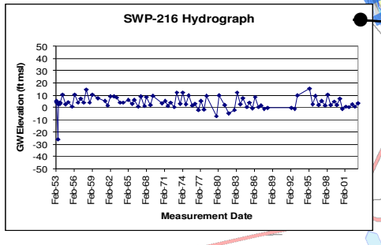


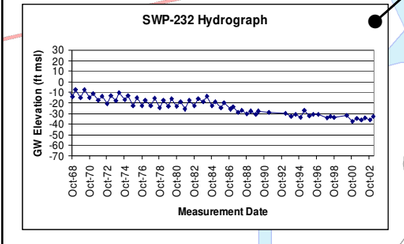


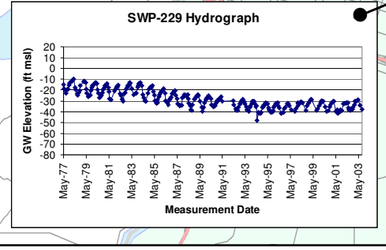


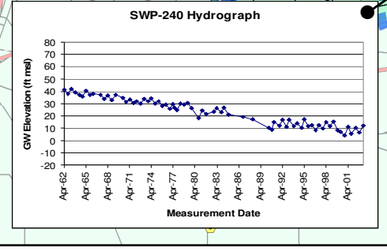












SWP-263
SWP-270
SWP-276
SWP-283
SWP-261
SWP-220
SWP-236
SWP-216
SWP-232
SWP-229
SWP-240

Figure 6

Long-Term Representative Hydrographs in the SGA Area

SGA

N

0 2 4 Miles

Scale 1:105,000
Projection: CA State Plane II
NAD83

Legend

- DWR Well with Hydrograph Data Shown
- DWR Well
- SGA Well
- SGA Boundary

Water Purveyors

- CALIFORNIA - AMERICAN WATER COMPANY
- CARMICHAEL WATER DISTRICT
- CITRUS HEIGHTS WATER DISTRICT
- CITY OF FOLSOM
- CITY OF SACRAMENTO
- DEL PASO MANOR WATER DISTRICT
- FAIR OAKS WATER DISTRICT
- NATOMAS CENTRAL MUTUAL WATER COMPANY
- ORANGE VALE WATER COMPANY
- RIO LINDA \ ELVERTA COMMUNITY WATER DISTRICT
- SACRAMENTO COUNTY WATER AGENCY
- SACRAMENTO SUBURBAN WATER DISTRICT
- SAN JUAN WATER DISTRICT
- SOUTHERN CALIFORNIA WATER COMPANY

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2.2.1.4 Sacramento River Contract Entitlements

One water purveyor within the SGA boundaries has a CVP contract entitlement on the Sacramento River: NCMWC. The POU for this water is the water company service area that includes both the Sacramento County and Sutter County areas.

2.2.1.5 Other Agreements

Sacramento has agreements with Sac Suburban (for use within the Arcade Service Area only) and DPMWD to make surface water available for use within the portions of their service areas that lie within Sacramento's POU.

Sac Suburban has a temporary contract with Reclamation for surplus water (often referred to as Section 215 water). This contract has been exercised since 1991. Sac Suburban's Section 215 supplies ranged between approximately 100 AF/year and 11,880 AF/year during the period 1991 through 2000. Section 215 water is available on an intermittent basis subject to hydrologic conditions.

2.2.2 Surface Water Quality

Based on current Update Reports to the Watershed Sanitary Surveys for the American and Sacramento Rivers, these are both excellent supplies for drinking water in the Sacramento Metropolitan Area. The source waters can be treated to meet all Title 22 drinking water standards using conventional and direct filtration processes, as well as membranes. There are no persistent constituents in the raw waters that require additional treatment processes. However, there are sometimes seasonal treatment requirements for rice herbicides on the Sacramento River, which can be addressed through chemical oxidation processes. High turbidities during storm events are sometimes a treatment challenge, which can be managed by optimizing operations including adjusting chemical types and dosing schemes and reducing plant flow (Montgomery Watson and Archibald & Wallberg, 2000).

2.2.2.1 American River

Surface water quality in the American River is a function of the mass balance of water quality from tributary streams, diversions, agricultural return flows, subsurface drainage flows, permitted discharges from municipal and industrial (M&I) sources, and urban runoff. In general, the quality of water in the American River is high from the river's headwaters to its confluence with the Sacramento River. It is low in alkalinity, low in disinfection by-product precursor materials, low in mineral content, and low in organic contamination. Limited data also indicate that the source of water is low in microbial contamination from *Giardia* and *Cryptosporidium*. Turbidity levels in the American River tend to be higher in the winter than summer because of higher flows associated with winter storms.

Folsom Reservoir. Water diverted from Folsom Reservoir is provided to the following SGA members: SJWD, CHWD, FOWD, OVWC, Folsom, and Sac Suburban[11]. Because the treatment facilities serving these areas share a common Folsom Dam intake facility, the raw water is considered to be similar with respect to quality. Characterization of Folsom Reservoir raw water quality is based on data collected by the Cities of Folsom and Roseville as well as SJWD.

Water diverted from the Folsom Dam is treated by SJWD and Folsom using conventional filtration processes with chlorine disinfection. Treated water quality varies depending on the specific type of treatment provided, but meets or exceeds all federal and state drinking water

[11] Water is also diverted, treated, and distributed by Roseville, located within Placer County.

standards for both SJWD and Folsom under current operations. Both agencies include corrosion control practices in their treatment of the water.

American River at CWD's Bajamont Way Membrane Filtration Water Treatment Plant. CWD uses American River water diverted by three Ranney Collectors for water supply, therefore this is groundwater under the direct influence of surface water. This source now supplies 80 percent of CWD's needs. The Collectors are located within the American River floodplain and adjacent to the streambed. They serve as intake and pump structures to provide pre-filtered water to the Bajamont Way Membrane Filtration (Bajamont) Water Treatment Plant (WTP). The Bajamont WTP has a design capacity of 16 million gallons per day (mgd) and can be expanded to 22 mgd. The WTP is composed of microfiltration membrane units. After filtration, the water is chlorinated with sodium hypochlorite and the pH is adjusted with caustic soda prior to distribution. The treated water meets all current Title 22 drinking water quality standards (Archibald & Wallberg and MWH, 2003).

Lower American River at Sacramento's E.A. Fairbairn Water Treatment Plant. Water is diverted by Sacramento on the lower American River just downstream of the Howe Avenue crossing at the E.A. Fairbairn WTP. This water may be used by other entities within the POU on a wholesale basis. Water diverted at the plant undergoes conventional treatment and disinfection. The treated water meets all current Title 22 drinking water quality standards (Archibald & Wallberg and MWH, 2003).

2.2.2.2 Sacramento River

Sacramento River water quality is largely influenced by a mass balance of water quality from upstream reservoir release operations, tributary flows (including the lower American River), agricultural runoff, subsurface drainage flows, and diversions, with other impacts from permitted discharges from M&I sources, urban runoff and spills. In general, the quality of the Sacramento River is high in the vicinity of the SGA boundary. There are moderate amounts of alkalinity and minerals and low levels of disinfection by-product precursors. Turbidity levels in the Sacramento River are higher during the winter and early spring months, usually associated with reservoir releases or runoff from storm events. There are very infrequent detects of organic chemicals, many of which are pesticides or herbicides from agricultural operations. Data collected to date indicate that there is a low prevalence of *Giardia* and *Crytposporidium* in the river, with protozoa only detected sporadically and at very low concentrations.

The characterization of the Sacramento River water quality in the vicinity of the SGA boundary is based on reports for the Sacramento River Water Treatment Plant (Sacramento River Watershed Sanitary Survey; 1995 Report and 2000 Update, prepared by MWH and Archibald & Wallberg).

Sacramento River at Sacramento's Sacramento River Water Treatment Plant. Water is diverted by Sacramento on the Sacramento River just downstream of the confluence with the American River. This water can be supplied to Sacramento and other entities within the place of use on a wholesale basis. Characterization of the Sacramento River raw water quality at the Sacramento River WTP is based on data collected by Sacramento (Sacramento River Water Treatment Plant – Finalization of Preliminary Design, prepared by Montgomery Watson, 1998).

Water is treated by Sacramento using conventional filtration processes with chlorine disinfection. Treated water quality meets or exceeds all federal and state drinking water standards under current operations. Sacramento includes corrosion control in their treatment of the water.

Primary drinking water standards are set for constituents that cause an adverse impact to human health. Secondary drinking water standards are set for constituents that cause an unpleasing aesthetic impact on the water quality; these are not health-based standards. There were no violations of primary or secondary drinking water standards reported for any of the characterization points discussed above.

2.3 "OTHER" SUPPLIES

Currently, limited opportunities exist for using recycled water north of the American River. In Sacramento County, the most probable recycled water opportunity exists at the Sacramento Regional Wastewater Treatment Plant (Sac Regional) located on the Sacramento River near Freeport (south of the American River and outside the SGA boundaries). At this time, however, Sac Regional does not appear to be a likely source of recycled water for the area north of the American River. The cost of pumping recycled water from Sac Regional to areas north of the American River is currently prohibitive. A more economic reclamation program might include the scalping of wastewater flows north of the American River for treatment at satellite plants.

In Placer County, Roseville has a recycled water program and is delivering recycled water for irrigation of golf courses and streetscape. Under this program, Roseville is studying potential locations for direct groundwater recharge with recycled water, in both Placer and northern Sacramento counties.

2.4 EXISTING FACILITIES AND OPERATIONS

2.4.1 Major Infrastructure

For the purposes of this GMP, the existing major infrastructure is divided into three major categories: surface water supply facilities, groundwater supply facilities, and system distribution/transmission and storage facilities. **Figure 7** presents a regional map of existing and planned principal infrastructure[12].

2.4.1.1 Surface Water Supply Facilities

There are four major diversion and treatment facilities on the American and Sacramento rivers that provide surface water within the SGA boundaries (see **Table 2**).

2.4.1.2 Groundwater Supply Facilities

The water purveyors within the SGA boundaries maintain and operate 269 groundwater wells (see **Table 3** and **Figure 6**). Most production capacities are in the range of 330 to 2,250 gallons per minute (gpm).

2.4.1.3 System Distribution/Transmission and Storage Facilities

The Cooperative Transmission Pipeline (CTP)/Northridge Transmission Pipeline (NTP) is the only existing major transmission facility capable of conveying water across the region. Major intra-agency transmission and distribution systems are also shown on **Figure 7**. Most agency-to-agency interconnections are presently used for emergency purposes only.

[12] Much of the planned infrastructure is attributable to the RWA's American River Basin Regional Conjunctive Use Program (see **Section 3** for a description). Individual agencies may be considering facilities that are not shown here.

Table 2. Treatment Capacity at WTPs Providing Surface Water within the SGA Boundaries

Source Water/Facility/Owner	Treatment Capacity (million gallons per day, mgd)
Folsom Reservoir	
Peterson WTP (SJWD)	120 [1]
Lower American River	
Bajamont WTP (CWD)	22
E.A. Fairbairn WTP (Sacramento)	200 [2]
Sacramento River	
Sacramento River WTP (Sacramento)	160 [2]

Notes:
[1] Planned improvements to solids handling system and backwash treatment will increase treatment capacity from 108 mgd (reliable capacity) to 120 mgd (design hydraulic capacity).
[2] Expansions to listed treatment capacities currently under way.

Table 3. Groundwater Wells within SGA Boundaries

Water Purveyor	Number of Groundwater Wells
Cal-Am	51
CWD	14
CHWD	11
Folsom	0
Sacramento	40
DPMWD	8
FOWD	8
NCMWC	0
OVWC	2
RLECWD	12
Sac Suburban	
Arcade Service Area	66
Northridge Service Area	32
SCWA	17
SCWC	8
SJWD	0
Individual representatives from agriculture and self-supplied groundwater users (principally parks and recreation districts)	-- [1]

Source: DMS, August 2003
NOTES:
[1] SGA does not have information on these wells.

Water purveyors that serve primarily groundwater (e.g., DPMWD) have little aboveground storage, relying instead on the groundwater basin for storage. Conversely, water purveyors that serve surface water (either partially or entirely) have made investments in aboveground storage for both raw and treated waters and associated pump stations. These purveyors include: Cal-Am, CWD, Sacramento, FOWD, Sac Suburban, and SJWD.

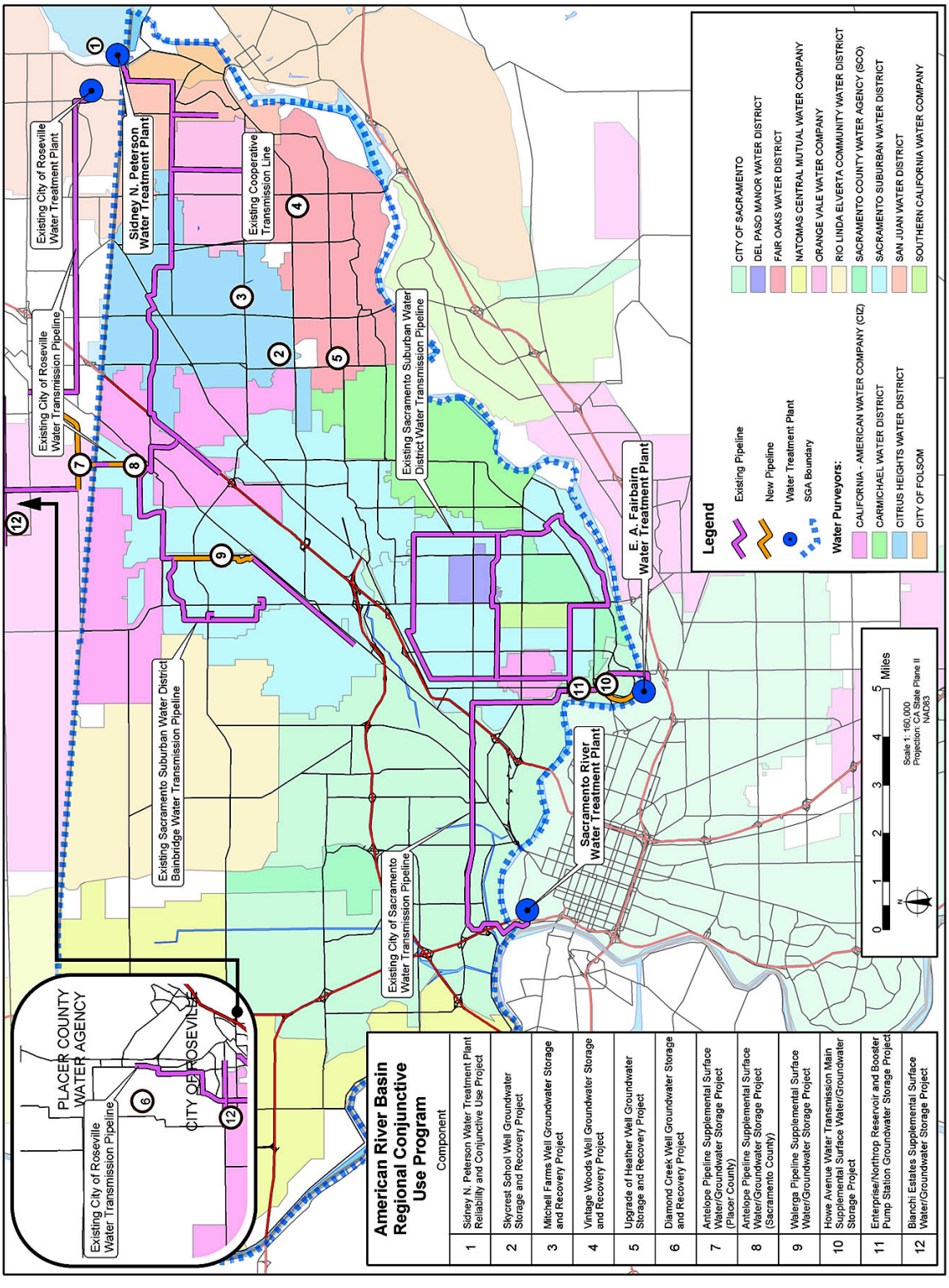


Figure 7. Existing Principal Infrastructure and Additional Infrastructure Resulting from American River Basin Regional Conjunctive Use Program

2.4.2 Operations

Recent (year 2002) surface water and groundwater use by the water purveyors within the SGA boundaries are shown in **Table 4** and on **Figure 8**. **Table 4** shows that Sacramento, Sac Suburban, and Cal-Am extracted the largest volumes of groundwater. These districts serve the largest, and some of the most densely populated, regions within the SGA boundaries. NCMWC, OVWC, Folsom, and SJWD extracted the least amount of groundwater. These agencies get the vast majority of their water from surface water sources, as shown in **Figure 8**. Total groundwater extraction by SGA member agencies during the last five years (1998 – 2002) is shown in **Figure 9**.

2.5 FUTURE FACILITIES AND OPERATIONS

Phase I of the RWMP identified and described a "menu" of project and program alternatives for implementing the WFA north of the American River. Phase II provided detailed hydrologic (including surface water and groundwater modeling), engineering (including conceptual design, operational analyses, and estimates of costs), and legal/institutional (including operational agreements and funding) evaluations of those projects and programs that best aligned with the goals and objectives of the individual water purveyors and the WFA. The recommendations resulting from Phase II were used to structure the SGA and RWA's regional projects and programs including: SGA-Sacramento Area Flood Control Agency (SAFCA) Pilot Study, 2002 CALFED Bay-Delta Program (CALFED) Environmental Water Account (EWA) Pilot Study, Sac Suburban's Groundwater Stabilization Project, Proposition 13 Groundwater Storage Program Construction Grant (i.e., American River Basin Regional Conjunctive Use Program or ARBCUP), and other ongoing efforts. Some of the planned infrastructure is shown in **Figure 7** and described in **Table 5**.

2.6 EFFECTS OF WFA IMPLEMENTATION

Implementation of the local conjunctive use program prescribed by the WFA will determine the year 2030 water supply scenarios for the water purveyors within the SGA's boundaries. (More detailed water purveyor-specific data are presented in **Appendix B**.) In general, the intent of the WFA is to increase the use of groundwater in dry years and reduce surface water diversions. The decrease in available dry year diversions is a consequence of the WFA objective to provide instream flows in the lower American River for environmental purposes. In wet years, when more surface water is available, diversion will be increased and groundwater extraction will be reduced, thereby promoting recharge of the basin.

2.6.1 Water Year Types

The WFA identifies three principal water year types. These year types are based on estimated March through November unimpaired inflow into Folsom Reservoir and are categorized as wet/average years, drier years, and driest years. For the water purveyors listed in **Table 4**, the specific year type criteria are stated.

Table 4. Year 2002 and Projected 2030 Water Supply Scenarios for Water Purveyors within SGA Boundaries

Water Purveyor	2002 Water Supply Scenario		Projected 2030 Water Supply Scenario [1]	
	Annual Demands [2] (AF/year)	Water Supply Mix, Surface Water/ Supplemental Supply[2], [3] (AF/year)	Annual Demands [4] (AF/year)	Water Supply Mixes by WFA Year Type, Surface Water/ Supplemental Supply[3] (AF/year)
Area "D" Agencies (within Sacramento's POU, north of American River) [5]:			**27,420**	W/A: 27,420/ 0 [7] Drier: 3,500/23,920 [7] Driest: 3,500/23,920 [7]
Cal-Am – Arden Service Area	-- [6]	-- [6]	3,340	
SCWA – Arden Park Vista Service Area	-- [6]	-- [6]	3,150	
DPMWD	1,692	0 / 1,692	1,570	
Sac Suburban – Arcade Service Area (Town & Country Sub-area)	-- [6]	-- [6]	17,990	
SCWC – Arden Town Service Area	1,317	0 / 1,317	1,370	
CWD	13,280	9,507 / 3,773	**12,000** [8]	W/A: 0/12,000 [9] Drier: 0/12,000 [9] Driest: 0/12,000 [9]
Folsom – north of American River only	1,149	1,149 / 0	-- [10]	-- [10]
Sacramento – north of American River only	51,732	26,734 / 24,998 [11]	**64,110**	W/A: 64,110/ 0 [12] Drier: -- [12] Driest: 42,110/ 22,000 [12]
NCMWC	88,028 [13]	88,028 / 0 [13]	**51,570**	W/A: 45,610/ 5,960 Drier: 45,610/ 5,960 Driest: 45,610/ 5,960
Sac Suburban and others within PCWA transfer water supply POU in Sacramento County:			**64,820**	W/A: 29,000/35,820 [15] Drier: 0/64,820 [15] Driest: 0/64,820 [15]
Cal-Am – Royal Oaks/Lincoln Oaks Service Areas	19,867 [6]	0 / 19,867 [6]	19,910	
RLECWD	3,367	0 / 3,367	18,690	
Sac Suburban:				
Arcade Service Area, North Highlands Sub-area	22,711 [6]	0 / 22,711 [6]	5,220	
Northridge Service Area	18,640	16,938 / 1,702 [11]	19,490	
McClellan AFB	-- [14]	-- [14]	1,510	
Sacramento International Airport	-- [16]	-- [16]	**6,260**	W/A: 0/ 6,260 [9] Drier: 0/ 6,260 [9] Driest: 0/ 6,260 [9]
SCWA – Northgate Service Area	5,279 [6]	0 / 5,279 [6]	**1,150**	W/A: 0/ 1,150 [9] Drier: 0/ 1,150 [9] Driest: 0/ 1,150 [9]
SJWD and consortium in Sacramento County			**43,920**	W/A: 43,920/ 0 [9] Drier: Ranging from [9],[18]
CHWD	19,913	17,617 / 2,296 [11]	16,420	43,920/ 0 to
FOWD	14,067	11,456 / 2,611 [11]	14,220	35,510/ 8,410
OVWC	4,377	4,377 / 0	6,750	Driest: 35,510/ 8,410 [9]
SJWD	4,661	4,661 / 0	6,530 [17]	
Individual representatives from agriculture and self-supplied groundwater users	-- [16]	-- [16]	-- [16]	-- [16]

Table 4. Year 2002 and Projected 2030 Water Supply Scenarios for Water Purveyors within SGA Boundaries (continued)

NOTES:

[1] Values rounded to nearest 10 AF.

[2] Surface water/supplemental water supply mixes from SGA DMS – year 2002 values as reported by individual water purveyors. Year 2002 water demands based on surface water/supplemental water supply mixes (assumes no shortages).

[3] Supplemental supplies may include groundwater extraction, demand management, and/or recycled water.

[4] From Cooperating Agencies RWMP, Phase II, Technical Memorandum 2, Table 1.

[5] Does not include portions of CWD and Sac Suburban (Northridge Service Area) also located within the Area "D" boundaries.

[6] SGA DMS reports data by water purveyor but not by service area.

[7] Assumes:
(1) Sac Suburban PSA accepted by Water Forum Successor Effort.
(2) Surface water from Sac Suburban and DPMWD contract agreements with Sacramento may be used within Area "D".
(3) Diversions at Fairbairn WTP are dependent upon flows bypassing the WTP exceeding the Hodge Flow Condition. (Hodge Flow Condition: Parties to the litigation (*Environmental Defense Fund et al. v. East Bay Municipal Utility District*) cannot divert water from the American River unless instream flows measure at least 2,000 cubic feet per second (cfs) from October 15 through February; 3,000 cfs from March through June; and 1,750 cfs from July through October 14.)

[8] CWD will divert up to its license amount of 14,000 AF. By the year 2030, it is most likely that the water demand for CWD will be reduced to their historic baseline level of 12,000 AF by implementation of the Urban Water Conservation Best Management Practices. Signatories to the WFA acknowledge and agree that CWD shall not relinquish control of or otherwise abandon the right to any quantity it has foregone delivery and/or diversion of under this Agreement, and shall retain the right (if any) to transfer that water for the other beneficial uses, after that water has served its purpose of assisting in the implementation of the Improved Pattern of Fishery Flow Releases, for diversion or rediversion at, near or downstream of the confluence of the lower American River.

[9] Wet/Ave Years: As it applies to these diverters, years when projected March through November Unimpaired Inflow to Folsom Reservoir is greater than 950,000 AF.
Drier Years: As it applies to these diverters, years when projected March through November Unimpaired Inflow to Folsom Reservoir is less than 950,000 AF.
Driest Years (i.e. Conference Years): Years when projected March through November Unimpaired Inflow to Folsom Reservoir is less than 400,000 AF. Conference years are those years that require diverters and others to meet and confer on how best to meet demands and protect the American River.

[10] Portion of Folsom (north of American River) included in SJWD.

[11] Data reflects participation in 2002 EWA Pilot Study.

[12] Wet/Average, Drier, and Driest year diversions are estimated. Diversions at Fairbairn WTP are dependent upon the flows bypassing the WTP exceeding the Hodge Flow Condition. (Hodge Flow Condition: Parties to the litigation (*Environmental Defense Fund et al. v. East Bay Municipal Utility District*) cannot divert water from the American River unless instream flows measure at least 2,000 cfs from October 15 through February; 3,000 cfs from March through June; and 1,750 cfs from July through October 14.)

[13] SGA DMS includes surface water diversions from both Sacramento and Sutter counties.

[14] McClellan AFB included in Sac Suburban (Northridge) data.

[15] Wet/Ave Years: As it applies to these diverters, years when projected March through November Unimpaired Inflow to Folsom Reservoir is greater than 1,600,000 AF.
Drier Years: As it applies to these diverters, years when projected March through November Unimpaired Inflow to Folsom Reservoir is less than 1,600,000 AF.

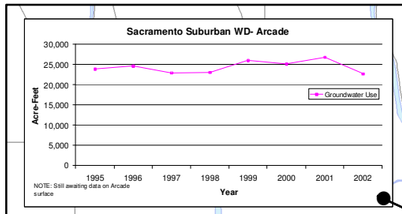
[16] Currently not tracked in the SGA DMS.

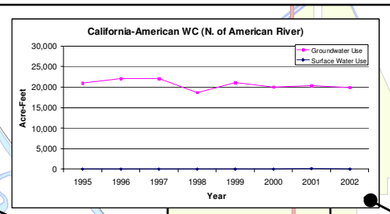
[17] Includes portion of Folsom (north of American River).

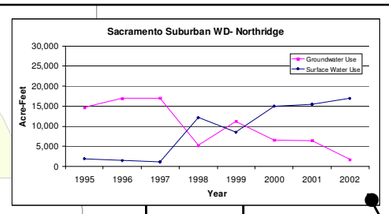
[18] Decrease in amount of surface water in proportion to the decrease in unimpaired flow from Folsom Reservoir.

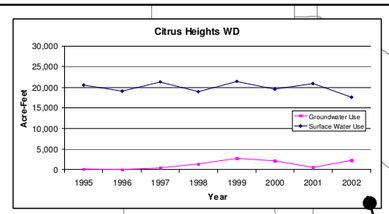
2.6.1.1 Definition of Wet/Average Years

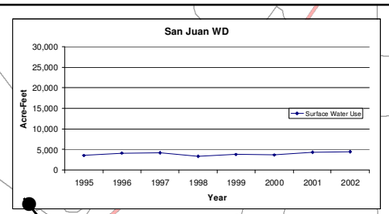
For most diverters, wet/average years are defined as those years when the projected March through November unimpaired inflow into Folsom Reservoir is equal to or greater than 950,000 acre-feet (AF). For Sac Suburban's water sale agreement with PCWA, a wet/average year is defined as a year when the March through November unimpaired inflow into Folsom Reservoir is greater than 1,600,000 AF. For Sacramento, diversions from the American River at the Fairbairn WTP are based on meeting the Hodge Flows in the lower American River.

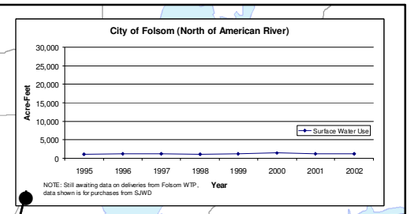






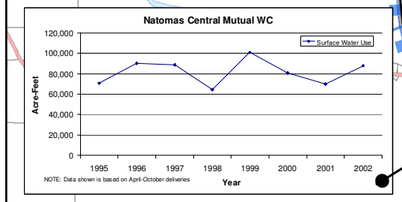


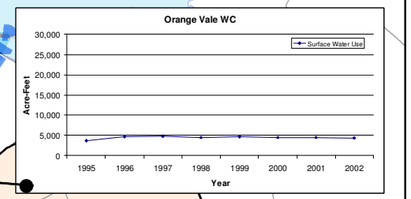


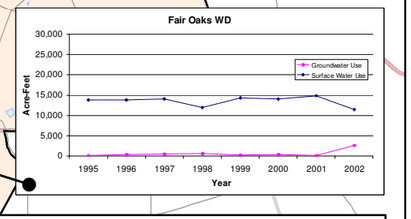


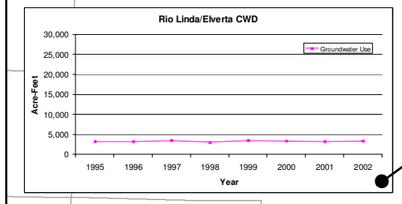
Agricultural Pumpers

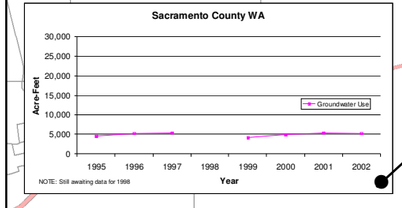
Groundwater extraction for agriculture in northwest Sacramento County was estimated at 10,500 acre-feet for 1990.

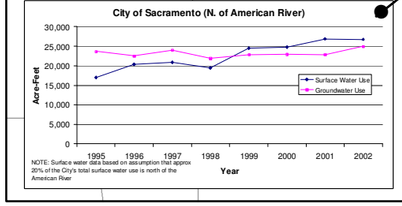


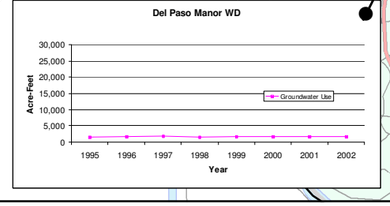


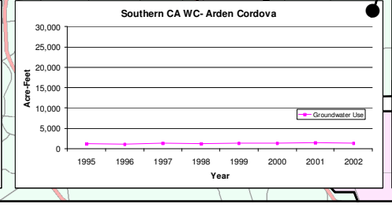


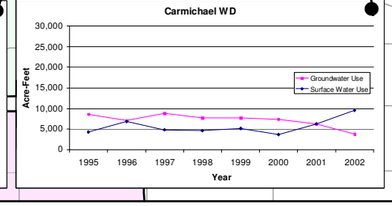












SGA

Figure 8

Use of Groundwater and Surface Water by Purveyor

N

Scale 1:105,000
Projection: CA State Plane II
NAD83

0 2 4 Miles

Legend

SGA Boundary

Water Purveyors

- CALIFORNIA - AMERICAN WATER COMPANY
- CARMICHAEL WATER DISTRICT
- CITRUS HEIGHTS WATER DISTRICT
- CITY OF FOLSOM
- CITY OF SACRAMENTO
- DEL PASO MANOR WATER DISTRICT
- FAIR OAKS WATER DISTRICT
- NATOMAS CENTRAL MUTUAL WATER COMPANY
- ORANGE VALE WATER COMPANY
- RIO LINDA \ ELVERTA COMMUNITY WATER DISTRICT
- SACRAMENTO COUNTY WATER AGENCY
- SACRAMENTO SUBURBAN WATER DISTRICT
- SAN JUAN WATER DISTRICT
- SOUTHERN CALIFORNIA WATER COMPANY

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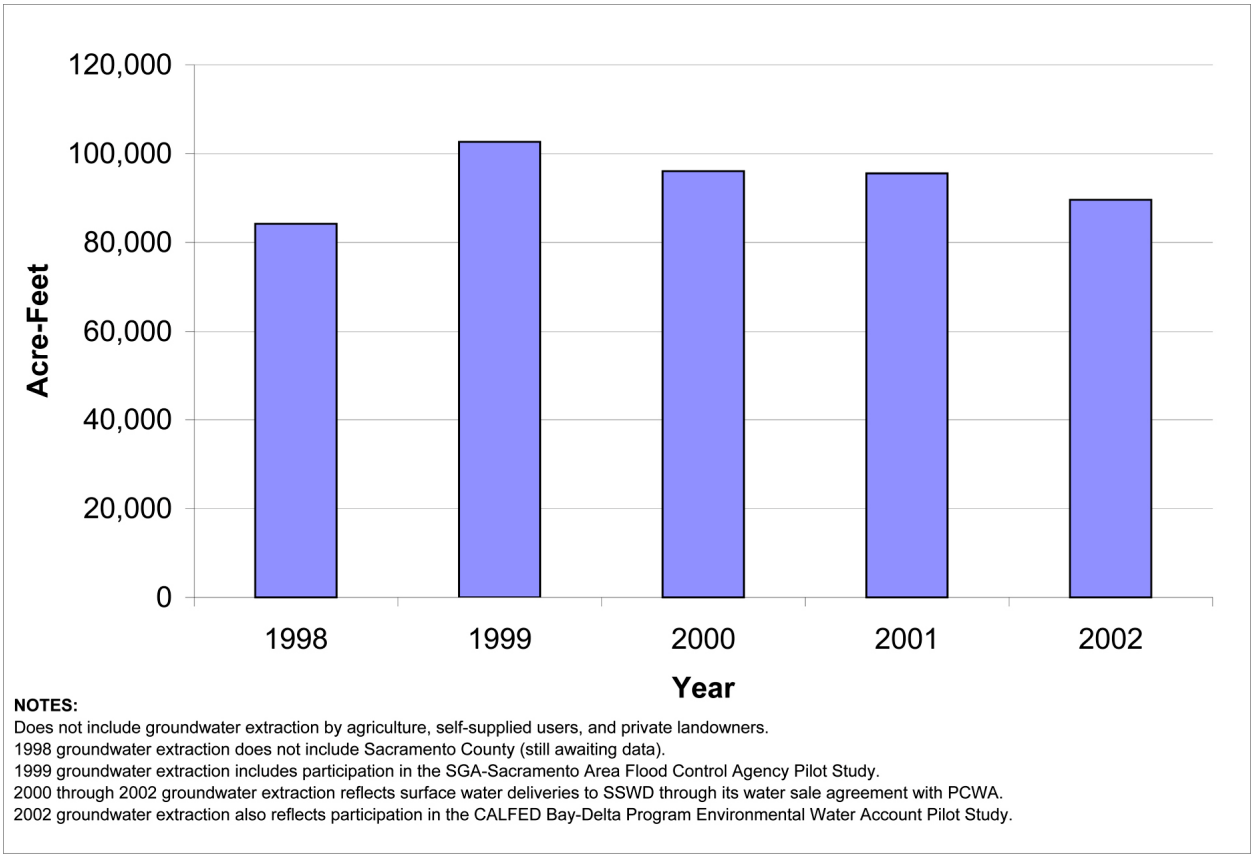

Figure 9. Total Annual Groundwater Extraction by SGA Member Agencies (1998 – 2002)

2.6.1.2 Definition of Drier Years

For most diverters, drier years are defined as those years when the projected March through November unimpaired inflow into Folsom Reservoir is less than 950,000 AF but equal to or greater than 400,000 AF.

2.6.1.3 Definition of Driest Years

The driest years, also referred to as "conference years", are defined as those year when the projected March through November unimpaired inflow into Folsom Reservoir is less than 400,000 AF.

2.6.2 WFA Water Supply Availability

Year 2030 implementation of the WFA will require increased groundwater extraction in the drier and driest years when less surface water is available from the American River. In the wet/average years, surface water diversions will be increased and groundwater pumping will be reduced. Projected year 2030 surface water and supplemental supply[13] use by the water purveyors within the SGA boundaries are shown in **Table 4**.

[13] Supplemental supplies may include groundwater extraction, demand management, and/or recycled water.

Table 5. RWA ARBCUP – Summary of Program Facilities

	Program Component	Operating Agency	Description	Grant Award Amount
1	Sidney N. Peterson WTP Reliability And Conjunctive Use Project	SJWD	WTP expansion and enhancement to increase rated capacity from 108 mgd (165 cfs) to 120 mgd (185 cfs)	$6,467,683
2	Skycrest School Well Groundwater Storage And Recovery Project	CHWD	Groundwater well (capacity up to 2,500 gpm and depth of 500 feet) to augment groundwater extraction capacity for CHWD	$506,225
3	Mitchell Farms Well Groundwater Storage And Recovery Project	CHWD	Groundwater well (capacity up to 2,500 gpm and depth of 500 feet) to augment groundwater extraction capacity for CHWD	$527,846
4	Vintage Woods Well Groundwater Storage And Recovery Project	FOWD	Groundwater well (capacity up to 2,500 gpm and depth of 600 feet) to augment groundwater extraction capacity for FOWD	$756,505
5	Upgrade Of Heather Well Groundwater Storage And Recovery Project	FOWD	Groundwater well (capacity up to 2,500 gpm and depth of 600 feet) to augment groundwater extraction capacity for FOWD	$667,371
6	Diamond Creek Well Groundwater Storage And Recovery Project	Roseville	Groundwater well (capacity of 2,000 gpm and depth of 400 feet) to augment the groundwater extraction capacity for Roseville	$786,111
7	Antelope Pipeline Supplemental Surface Water / Groundwater Storage Project (Placer County)	Roseville	Interconnection pipeline (portion within Placer County) connecting SJWD's Peterson WTP and Roseville WTP. Length is approx. 12,000 linear feet (2.3 miles) with 24-and 36-inch diameter pipeline, and capacity of 20 mgd (30 cfs)	$2,000,069
8	Antelope Pipeline Supplemental Surface Water / Groundwater Storage Project (Sacramento County)	Sac Suburban	Interconnection pipeline (portion within Sacramento County) connecting SJWD's Peterson WTP and Roseville WTP. Length is approx. 3,500 linear feet (.7 miles) with 36-inch diameter pipeline, and capacity of 20 mgd (30 cfs)	$1,294,327
9	Walerga Pipeline Supplemental Surface Water / Groundwater Storage Project	Sac Suburban	Interconnection pipeline will provide enhanced ability to deliver treated surface water to southern portion of Sac Suburban's Northridge Service Area and to McClellan AFB. Length is approx. 8,195 linear feet (1.6 miles) with 36-inch diameter pipeline, and capacity of 20 mgd (30 cfs)	$2,662,391
10	Howe Avenue Water Transmission Main Supplemental Surface Water / Groundwater Storage Project	Sacramento	Transmission main will provide additional capacity across American River for delivery to Sacramento and Sac Suburban's Arcade Service Area. Length is approx. 6,446 linear feet (1.2 miles) with 54-inch diameter pipeline, and capacity of 50 mgd (80 cfs)	$3,861,067
11	Enterprise / Northrop Reservoir And Booster Pump Station Groundwater Storage Project	Sac Suburban	Facility includes above-ground treated water storage reservoir for flow equalization and pump station for boosting treated water out of Sacramento's water transmission line into Sac Suburban's Arcade Service Area. Size of the storage tank is 5 million gallons (15 AF) and capacity of pump station is 20 mgd (30 cfs)	$2,078,266
12	Bianchi Estates Supplemental Surface Water/Groundwater Storage Project	PCWA	Project includes pipeline tie-in and individual property water meters for 46 residential customers that have historically relied on groundwater. By changing to surface water supply, 45 AF of water will be recharged annually into basin through in-lieu recharge. Additionally, project will include property owner conservation training, which in combination with meters will promote water use efficiency	$63,836
				$21,671,697

2.6.2.1 Water Use by Year Type

Water Use in Wet/Average Years. In wet/average years, surface water diversions will be maximized. In those years, surface water use by the water purveyors within the SGA boundaries will total approximately 222,060 AF/year. Estimates for each water purveyor's surface water use in wet/average years are shown in **Table 4**.

Supplemental supplies will make up the difference between demands and available surface water supplies. In wet/average years, the need for supplemental supplies is estimated to be approximately 49,190 AF/year and is generally assumed to be met with groundwater supplies. It should be noted that this is well below the 131,000 AF/year long-term sustainable yield estimate cited in the WFA. Estimates for each water purveyor's supplemental supplies in a wet/average year are shown in **Table 4**.

Water Use in Drier Years. In drier years, surface water diversions will be less than those in wet/average years, ranging from 169,140 to 138,730 AF/year. In drier years, the annual diversion amounts prescribed in the WFA are on a sliding scale based on the inflow to Folsom Reservoir. Estimates for each water purveyor's surface water use in wet/average years are shown in **Table 4**.

Supplemental supplies will make up the difference between demands and available surface water supplies. The need for supplemental supplies is estimated to range from 102,110 to 132,520 AF/year. It should be noted that in some drier years, the groundwater extraction rate will exceed the 131,000 AF/year long-term sustainable yield estimate cited in the WFA. Estimates for each water purveyor's surface water use in drier years are shown in **Table 4**.

Water Use in Driest Years. In the driest years, surface water diversions will be minimized, totaling 138,730 AF/year. As shown in **Table 4**, this is approximately an 83,330 AF/year reduction in diversions from the wet/average years. In the driest years, the need for supplemental supplies will increase to 132,520 AF/year. The majority of these supplemental supplies will be derived from groundwater extraction, exceeding the 131,000 AF/year long-term sustainable yield estimate cited in the WFA.

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3 MANAGEMENT PLAN ELEMENTS

The elements of this GMP include an overall goal, a set of management objectives, and a series of plan components that discuss and identify the actions necessary for meeting the goal and objectives (see **Figure 10**).

3.1 GROUNDWATER MANAGEMENT GOAL

The goal of this GMP is to ensure a viable groundwater resource for beneficial uses including agricultural, industrial, and municipal supplies that support the WFA's co-equal objectives of providing a reliable and safe water supply and preserving the fishery, wildlife, recreational, and aesthetic values of the lower American River.

3.2 BASIN MANAGEMENT OBJECTIVES

To meet the goal stated above, the SGA has adopted five specific basin management objectives (BMOs). These BMOs include the following:

1. **Maintain or improve groundwater quality in the SGA area for the benefit of basin groundwater users.** The groundwater supplied for public consumption meets all public health criteria. However, occurrences of large-scale groundwater contamination are documented in the basin. It is the intent of the SGA that use of groundwater by member agencies in the basin is not hindered by contamination, and that such use does not cause degradation of the quality of the resource. Where contamination is documented, or occurs in the future, the SGA will coordinate with appropriate state and federal regulatory agencies to pursue actions that result in the containment and eventual remediation of the contaminant.

2. **Maintain groundwater elevations that result in a net benefit to basin groundwater users.** Over the past several decades, the extensive groundwater pumping to support urban development has resulted in a persistent cone of depression. The lowering of groundwater elevations can have adverse impacts ranging from increased energy costs to the need to deepen existing wells or even construct new ones. Increased conjunctive use in the basin, particularly additional groundwater extraction during drier years, may result in short-term water levels being drawn down below previous historical lows. The SGA intends that the impacts during these times be minimized and that overall groundwater levels in the basin be improved over time from the present condition.

3. **Protect against any potential inelastic land surface subsidence.** Land subsidence can cause significant damage to essential infrastructure. Historic land surface subsidence within the SGA area has been minimal, with no known significant impacts to existing infrastructure. Given the historical trends, the potential for land surface subsidence from groundwater extraction in the north area basin is remote. However, the SGA intends to monitor for potential land surface subsidence. If inelastic subsidence is documented in conjunction with declining groundwater elevations, the SGA will investigate appropriate actions to avoid adverse impacts.

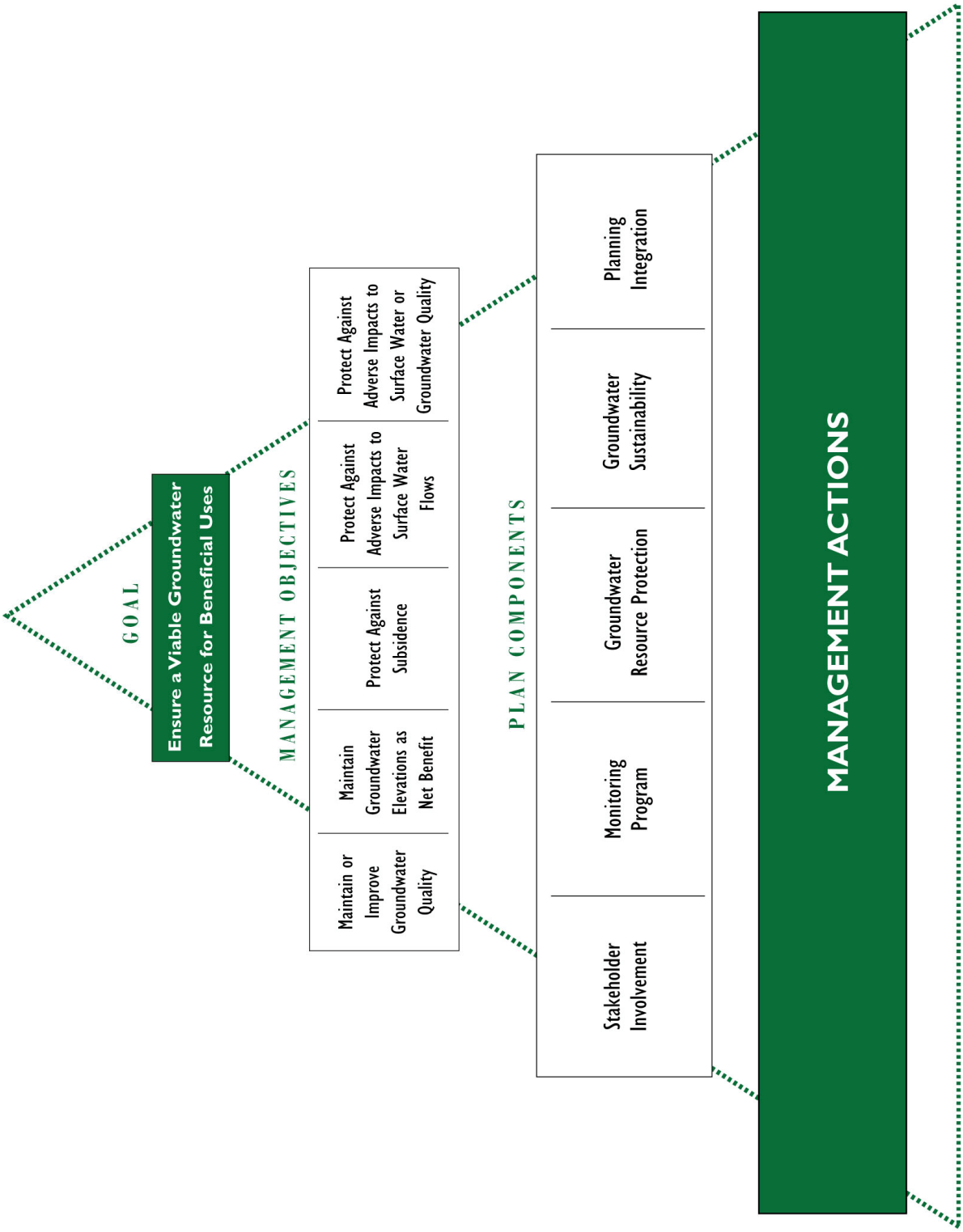

Figure 10. Organization of Management Plan Elements

4. **Protect against adverse impacts to surface water flows in the American River and Sacramento River.** Among other important uses, the American and Sacramento rivers provide habitat for a variety of fish and wildlife species. The SGA and its members are committed to the objectives of the WFA, including the objective to protect and enhance the lower American River. Important elements of the WFA include commitments to reduce lower American River diversions during dry years and to not exceed agreed upon groundwater extractions of 131,000 AF/year on average. In addition, the SGA plans to monitor and evaluate the relationship (if any) between groundwater pumping and adjacent river or stream flows.

5. **Protect against adverse impacts to water quality resulting from interaction between groundwater in the basin and surface water flows in the American River and Sacramento River.** In most natural settings, groundwater is higher in TDS and most other constituents than surface water. At the present time, the flow regime is such that groundwater is not discharging to the river systems in the SGA area. It is possible that future actions could temporarily alter that condition. It is the SGA's intent that controllable operations of the groundwater system do not negatively impact the water quality of the area's rivers and streams. The SGA will seek to gain a better understanding of potential impacts of the discharge of local-area groundwater to surface water channels.

3.3 GMP COMPONENTS

The GMP includes a variety of components that are required by CWC § 10753.7, recommended by DWR Bulletin 118 (2003), optional under CWC § 10753.8, and other components that the SGA has already begun. These components can be grouped into five general categories: (1) stakeholder involvement, (2) monitoring program, (3) groundwater resource protection, (4) groundwater replenishment, and (5) planning integration. Each category and its components are presented in this section. Under each component is a discussion, proposed actions, and identification of the objectives toward which the component is directed.

3.4 COMPONENT CATEGORY 1: STAKEHOLDER INVOLVEMENT

The management actions taken by the SGA may have a wide range of impacts on a broad range of individuals and agencies that ultimately have a stake in its successful management of the basin. The local consumer may be most concerned about water rates or assurances that each time the tap is turned a steady, safe stream of water is available. To large state and federal water resource agencies, the degree to which the SGA can achieve local supply reliability and further banking and exchange programs enhances the state and federal programs' opportunity to meet statewide needs, particularly in drier years. To address the needs of all of these stakeholders, the SGA has pursued several means of achieving broader involvement in the management of the North Area Groundwater Basin. These include: (1) involving members of the public, (2) involving other local agencies within and adjacent to the SGA area, (3) using advisory committees for development and implementation of the GMP, (4) developing relationships with state and federal water agencies, and (5) pursuing a variety of partnerships to achieve local supply sustainability. Each of these is discussed further below.

3.4.1 Involving the Public

Groundwater in California is a public resource, and the SGA is committed to involving the public in the development and implementation of its GMP. When the JPA creating the SGA was signed by the cities of Citrus Heights, Folsom, and Sacramento and the County of Sacramento,

those entities chose an inclusive governance structure consisting of Board membership from all water suppliers overlying the SGA portion of the basin. Many of these Board members are elected officials representing the various water districts and the citizens they serve.

In the preparation of this GMP, the SGA has filed four separate notices in the Sacramento Bee (**Appendix C**). In accordance with CWC § 10753.2, a notice of intent to adopt a resolution to prepare a GMP and inviting the public to the August 14, 2003 SGA Board meeting was published. Upon adoption of the resolution of intent, the resolution was also published in the Sacramento Bee. Additionally, a separate notice inviting the public to participate in developing the GMP and explaining how they could do so was published in May 2003 in the Sacramento Bee. Finally, the SGA provided a public comment period on the draft GMP and noticed and held a second meeting for the public to comment on the GMP prior to its adoption.

The SGA has also demonstrated its commitment to outreach and education. In addition to all required public notification, the SGA prepared a public outreach plan as part of a partnership with DWR. The plan includes many strategies for communicating with both internal and external audiences for various aspects of the program. The Public Outreach Plan Summary from the report by Lucy & Company (2003) is included in **Appendix C**.

In November 2003, the SGA released a Web site (www.sgah2o.org). The SGA will use its Web site to distribute information on GMP implementation activities to the public.

Actions. The SGA will take the following actions:

1. Continue efforts to encourage public participation as opportunities arise.
2. Review and take actions from the public outreach plan as necessary during implementation of various aspects of the GMP.
3. Provide briefings to the Water Forum Successor Effort on GMP implementation progress.
4. Work with members to maximize outreach on GMP activities including the use of the SGA Web site, member Web sites, or bill inserts.

3.4.2 Involving Other Agencies Within and Adjacent to the SGA Area

The SGA's legal boundary is limited to that of the JPA signatories in Sacramento County north of the American River. This includes all of Sacramento County north of the American River. All water purveyors in northern Sacramento County are SGA members and are participating in the development and implementation of this GMP. **Figure 11** shows the SGA purveyors and some of the key adjacent entities that SGA has begun coordinating with during development of the GMP. One key agency within the SGA boundary that is not a water purveyor is the Air Force Real Property Agency (AFRPA), which oversees remediation efforts of contaminated soil and groundwater at the former McClellan AFB. The SGA and the AFRPA have established a committee to meet and discuss issues related to groundwater management and remediation efforts at the former McClellan AFB, and is integrating some of the monitoring wells at McClellan AFB into the SGA monitoring network (see **Section 3.5**).

Other users in the basin not noted on **Figure 11** include agriculture and other self-supplied groundwater producers. The SGA should ensure effective outreach to these groups.

The SGA boundary covers approximately the southern one-third of the North American Subbasin as defined by DWR (**Figure 2**). The remainder of the subbasin includes portions of Sutter and Placer counties.

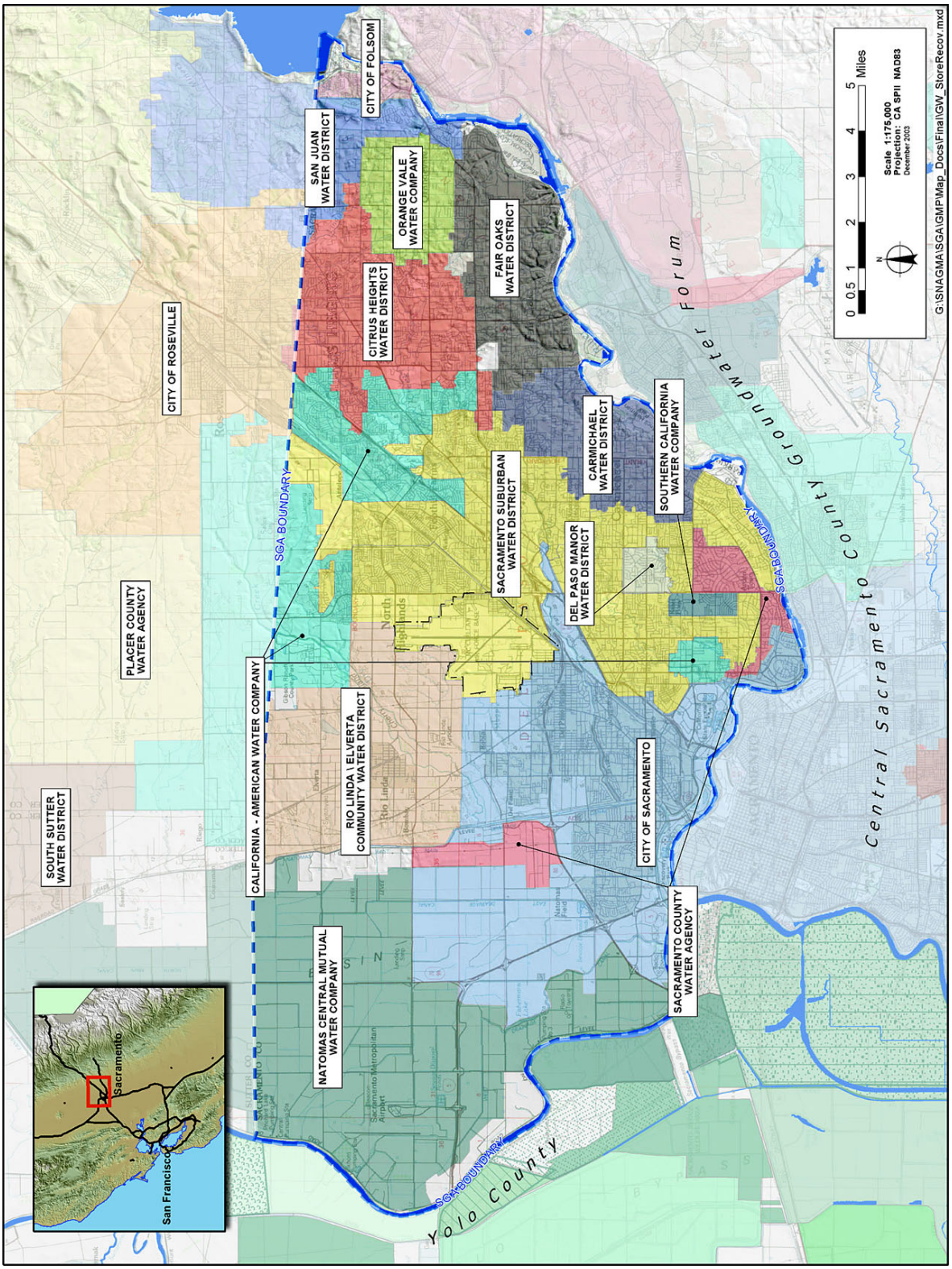

Figure 11. SGA Member Agencies and Other Adjacent Local Agencies

In 2000, NCMWC adopted a GMP for its service area in both Sacramento and Sutter counties (Luhdorff & Scalmanini Consulting Engineers (LSCE), 2000). That GMP will continue to apply to NCMWC's Sutter County service area, while the SGA GMP will be in effect for the Sacramento County portion. NCMWC and SGA are coordinating to ensure that NCMWC's management needs continue to be met in Sacramento County through the SGA GMP.

In Placer County, the SGA is closely connected to groundwater management activities through the RWA. PCWA, Roseville, and the City of Lincoln (Lincoln) are all members of the RWA. PCWA adopted an AB 3030 GMP in 1998, which includes Roseville. PCWA adopted an updated GMP in compliance with SB 1938 in November 2003. The RWA Executive Director is on a steering committee for implementation of the West Placer County Groundwater Management Plan. Lincoln is not covered by the PCWA plan, and adopted its own SB 1938-compliant GMP in November 2003. The RWA Executive Director is a member of the Advisory Committee organized to develop and implement that plan. Finally, SGA staff have briefed PCWA staff responsible for groundwater management on the SGA GMP development and have designated a representative from Placer County as a member of the SGA GMP Technical Review Committee (see **Section 3.4.3**).

In Sutter County, much of the subbasin is managed either by South Sutter Water District (South Sutter) or by NCMWC. NCMWC is an SGA member although the Sutter County portion of the district does not fall under this GMP because it is beyond the boundaries of the SGA's authority. South Sutter adopted an AB 3030 GMP in 1995. South Sutter provided a copy of that GMP to the SGA, and the SGA provided a briefing to the South Sutter General Manager on its current GMP development efforts. Finally, the SGA appointed a representative from Sutter County Department of Public Works as a member of the SGA GMP Technical Review Committee.

In addition to involving other agencies within the North American Subbasin, the SGA has briefed representatives of Yolo County (representing the Yolo Subbasin) to the west and the Central Sacramento County Groundwater Forum (or Groundwater Forum, representing the South American Subbasin) to the south. The SGA also maintains close coordination with the Central Sacramento County through the RWA by being an active associate member of the Groundwater Forum's water purveyor interest group.

Actions. The SGA will take the following actions:

1. Continue high level of involvement demonstrated through the SGA GMP development into implementation of the plan by continued participation on committees described above.
2. Provide copies of the adopted GMP and subsequent annual reports to representatives from Placer, Sutter, and Yolo counties, and the Groundwater Forum.
3. Meet with representatives from Placer, Sutter, and Yolo counties, and the Groundwater Forum as needed.
4. Coordinate a meeting with agricultural pumpers in the SGA area to inform them of the SGA's management responsibilities and activities, and develop a list of agricultural groundwater pumpers concerns and needs relative to the SGA's management of the area.
5. Coordinate a meeting with other self-supplied pumpers in the SGA area to inform them of the SGA's management responsibilities and activities, and develop a list of self-supplied groundwater pumpers concerns and needs relative to the SGA's management of the area.

3.4.3 Utilizing Advisory Committees

The SGA is committed to using advisory committees in its GMP development and implementation. Prior to beginning development of the GMP, the SGA Board appointed an ad hoc committee to make recommendations for the composition of a Policy Committee and Technical Review Committee to guide development of the GMP. The ad hoc committee recommended that the Policy Committee be composed of SGA members representing the overall composition of the groundwater users within the SGA boundaries and that the Technical Review Committee include broader membership including agencies outside the SGA boundaries to consider technical issues related to the plan. Each committee met on approximately a monthly basis during GMP development.

The primary groups represented on the Policy Committee include:

- Cal-Am
- Sacramento
- NCMWC
- Sac Suburban
- San Juan Family[14]
- Agriculture

The primary groups represented on the Technical Review Committee include:

- Sacramento
- NCMWC
- Placer County/Roseville
- Sac Suburban
- San Juan Family
- DWR
- Sutter County

Actions. The SGA will take the following action:

1. Upon adoption of the GMP, the Policy Committee will meet to discuss the continuation and composition of committees to guide implementation of the plan. Provide these recommendations to the SGA Board of Directors.

3.4.4 Developing Relationships with State and Federal Agencies

Working relationships between the SGA and the local, state, and federal regulatory agencies are critical to developing and implementing the various groundwater management strategies and actions detailed in this GMP. Examples of the SGA, RWA, Cooperating Agencies, and their member agencies working cooperatively with the regulatory agencies include:

- **Cooperating Agencies RWMP.** Both Reclamation and DWR participated in and provided funding for the RWMP effort (Phases I and II).

[14] The San Juan Family is comprised of SJWD, CHWD, FOWD, OVWC, and Folsom (north of the American River).

- **Banking and Exchange Program.** A partnership of the Cooperating Agencies and the SGA was the first signatory of a Memorandum of Understanding with DWR's Integrated Storage Investigation (ISI) in March 2000. The potential for a regional banking and exchange program was investigated through pilot studies and related activities. DWR's ISI provided funding for this effort.
- **SGA-SAFCA Pilot Study.** In 1999/2000, the SGA's first pilot study was conducted in conjunction with a local flood control agency (SAFCA) and Reclamation.
- **EWA Pilot Study.** In 2002, SGA's pilot study was the first water acquisition made by Reclamation on behalf of the EWA.
- **SGA DMS.** The U.S. Army Corps of Engineers (USACE) and DWR participated in the development of and provided funding for the SGA DMS (Phases I and II).
- **American Basin Conjunctive Use Feasibility Study.** In the mid-1990s, DWR conducted a feasibility study of conjunctive use parts of Sacramento, Sutter, and western Placer counties. NCMWC, an SGA member, was a cooperator in the study. The investigation serves as a good example of developing relationships between state and local agencies.

The SGA also coordinates and develops working relationships with other local, state, and federal regulatory agencies (e.g., Sacramento County, California Department of Health Services (DHS), U.S. Environmental Protection Agency (USEPA), etc.), as appropriate.

Actions. The SGA will take the following action:

1. Continue to develop working relationships with local, state, and federal regulatory agencies.

3.4.5 Pursuing Partnership Opportunities

The SGA is committed to facilitating partnership arrangements at the local, state, and federal levels. In the past decade, Sacramento-area water community and other local leaders have made great strides toward regional planning and collaboration on water issues. The historic WFA, which involved over 40 stakeholders and 7 years of facilitated discussions, resulted in a regional framework to balance the competing demands for increased use of surface and groundwater with the environmental needs of the lower American River through the year 2030. Several important partnerships have been formed to implement the WFA as well as provide a host of other benefits to water agencies and the customers that they serve.

The SGA itself is a unique partnership between the cities and county entering a joint powers agreement and allowing the agency to be overseen by a board of local water purveyors and self-supplied and agricultural interests. Regionally, the SGA is closely partnered with the RWA, the Water Forum Successor Effort, and the Cooperating Agencies. Together these activities define and support a conjunctive use program, which is critical to supporting the overall management goal of a safe and reliable water supply.

While the facilities necessary for local supply reliability through 2030 have been identified through the RWMP, the potential exists to expand conjunctive use operations in the basin to achieve broader regional and statewide benefits. The needed facilities, however, would require substantial resources. To investigate any further opportunities would require resources provided through partnerships from potential beneficiaries.

Actions. The SGA will take the following actions:

1. Continue to promote partnerships that achieve both local supply reliability and achieve broader regional and statewide benefits.
2. Continue to track grant opportunities to fund groundwater management activities and local water infrastructure projects.

3.5 COMPONENT CATEGORY 2: MONITORING PROGRAM

At the heart of this GMP is a monitoring program capable of assessing the status of the basin and responses in the basin to future management actions. The program includes the monitoring of groundwater elevations, monitoring of groundwater quality, monitoring and assessing the potential for land surface subsidence resulting from groundwater extraction, and developing a better understanding of the relationship between surface water and groundwater along the American and Sacramento rivers. Also important is the establishing of monitoring protocols to ensure the accuracy and consistency of data collected. Finally, the monitoring program includes a tool, the DMS, for assembling and assessing the groundwater-related data in the North Area Groundwater Basin.

3.5.1 Groundwater Elevation Monitoring

The SGA has compiled historic water level data measurements extending from prior to 1950 through 2002. Sources of historic water level data for the SGA area include:

- DWR/SCWA
- SGA Member Agencies
- USGS
- CSUS

DWR and SCWA have maintained a program of measuring more than 30 wells in the basin, from which SCWA routinely generates annual contour maps for the county. However, the wells monitored have been added to and dropped off of the network over time, so it is difficult to compare a historic contour plot to a recent one. For this reason, the SGA is establishing a standardized network of wells that combines those monitored by DWR and SCWA with wells from member water purveyors and other sources. It is the SGA's intent that these wells be maintained as a consistent long-term network that represents overall groundwater elevation conditions in the basin. **Figure 12** shows the wells currently proposed for this network.

The wells were selected to provide uniform geographic coverage throughout the 195 square mile SGA area, and in an area around the northern, western, and southern perimeter of the SGA[15]. The well network was developed by first establishing a network of sampling grids using the following method:

- Overlay a matrix of evenly spaced points over the SGA area.
- Surround matrix of points with polygons.
- Conform boundaries of polygons to the SGA boundaries and regenerate area grids.

[15] No wells were selected east of the boundary because it is in consolidated rock outside of the groundwater basin.

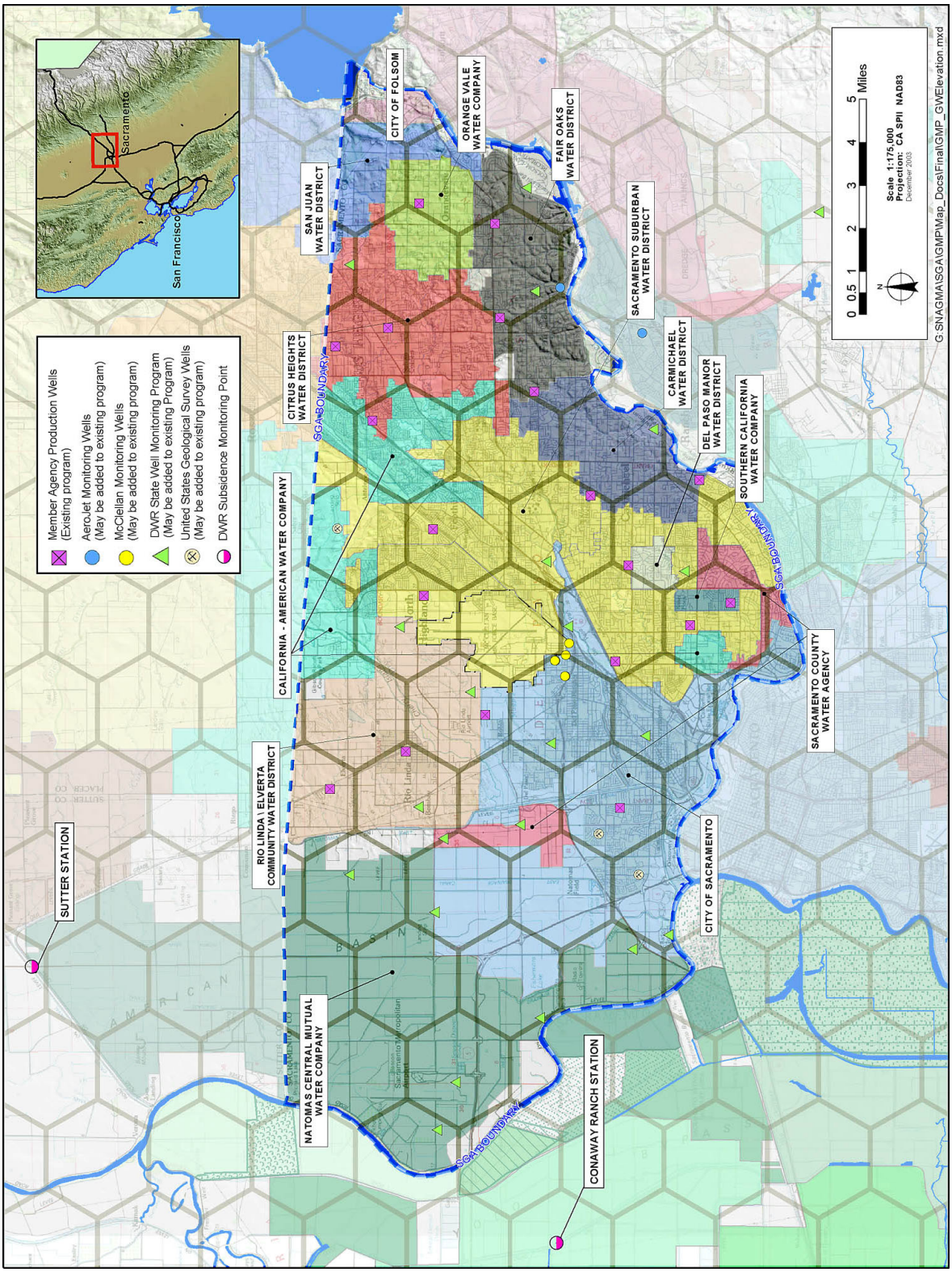

Figure 12. Initial Proposed Wells for Consideration in SGA Groundwater Elevation Monitoring Network

The resulting grid, shown on **Figure 12,** includes 44 polygons of roughly equal area of about five square miles each. The proposed set of member agency monitoring wells were selected from the DMS to represent water levels for as many polygons as possible. Individual wells were selected by:

- Giving preference to wells currently in DWR's and SCWA's monitoring program. These wells were selected because (a) they have long records of historic water level data and are useful in assessing trends within the groundwater basins, (b) uniform protocols were used in measuring and recording the water level data, and (c) these are non-producing wells, so water level readings represent relatively static levels.
- Identifying member agency wells with well construction information, long records of water level data and giving preference to those wells with the lowest recent extraction volumes.
- Plotting the location of USGS wells within the SGA area and choosing wells in those areas void of DWR or member agency wells.

Actions. Additional actions by the SGA will include:

1. Coordinate with member agencies and DWR to identify an appropriate group of wells for monitoring for a spring 2004 set of groundwater elevation measurements.
2. Coordinate with DWR and SCWA to ensure that the selected wells are maintained as part of a long-term monitoring network.
3. Coordinate with DWR and SCWA to ensure that the timing of water level data collection by member agencies coincides within one month of DWR and SCWA data collection. Currently DWR and SCWA collect water level data in the spring and fall.
4. Coordinate with member agencies to ensure that needed water level elevations are collected and verify that uniform data collection protocols are used among the agencies.
5. Coordinate with the USGS to determine the potential for integrating USGS monitoring wells constructed for the NAWQA Program into the SGA monitoring network.
6. Consider ways to fill gaps in the monitoring well network by identifying additional suitable existing wells or identifying opportunities for constructing new monitoring wells.
7. Assess groundwater elevation trends and conditions based on the network annually.
8. Assess the adequacy of the groundwater elevation monitoring well network annually.
9. Identify a subset of monitoring wells that will be monitored more frequently than twice annually to improve the SGA's understanding of aquifer responses to pumping throughout the year.

3.5.2 Groundwater Quality Monitoring

Because most of the wells in the basin are used for public water supply, an extensive record of water quality data is available for most wells dating from about 1985 to present. The SGA has compiled available historic water quality data for constituents monitored as required by DHS under Title 22. Sources of water quality data include:

- DWR
- SGA Member Agencies

- USGS
- CSUS

This level of monitoring is sufficient under existing regulatory guidelines to ensure that the public is provided with a safe, reliable drinking water supply. It would ultimately be important to have in place a network of shallow (less than 200 feet deep), dedicated monitoring wells to serve as an early warning system for contaminants that could make their way to the greater depths in the basin where SGA members primarily extract groundwater. The SGA has identified the locations of several wells associated with the USGS NAWQA program and is working with AFRPA to identify a subset of the approximately 400 monitoring wells located in and around the former McClellan AFB for integration into the SGA monitoring effort. The SGA will also coordinate with the CVRWQCB, which oversees the remediation of LUSTs, to identify existing dedicated monitoring wells in the basin.

Figure 13 shows the existing SGA member agency production wells. Title 22 water quality reporting is required by DHS for each of these public drinking water supplies. The SGA's water quality monitoring network includes these wells. The water quality monitoring well network may be expanded to include additional DWR, USGS, McClellan AFB, Aerojet, CVRWQCB, and privately owned wells, based on the outcome of coordination meetings with these agencies.

Actions. The following actions will be taken by the SGA to monitor and manage groundwater quality:

1. Coordinate with member agencies to verify that uniform protocols are used when collecting water quality data.
2. Coordinate with the USGS to obtain historic water quality data for NAWQA wells, determine timing and frequency of monitoring under USGS program, and to discuss the potential for integrating USGS monitoring resources with the SGA network.
3. Coordinate with member agencies and other local, state, and federal agencies to identify where wells may exist in areas with sparse groundwater quality data. Identify opportunities for collecting and analyzing water quality samples from those wells.
4. Assess the adequacy of the groundwater quality monitoring well network annually.

3.5.3 Land Surface Elevation Monitoring

Subsidence of the land surface resulting from compaction of underlying formations affected by head (water level) decline is a well-documented concern throughout much of the Central Valley. During a typical pumping season, changes in land surface elevation can be observed as a result of both elastic and inelastic subsidence in the underlying basin. Elastic subsidence results from the reduction of pore fluid pressures in the aquifer and typically rebounds when pumping ceases or when groundwater is otherwise recharged resulting in increased pore fluid pressure. Inelastic subsidence occurs when pore fluid pressures decline to the point that aquitard (a clay bed of an aquifer system) sediments collapse resulting in permanent compaction and reduced ability to store water in that portion of the aquifer.

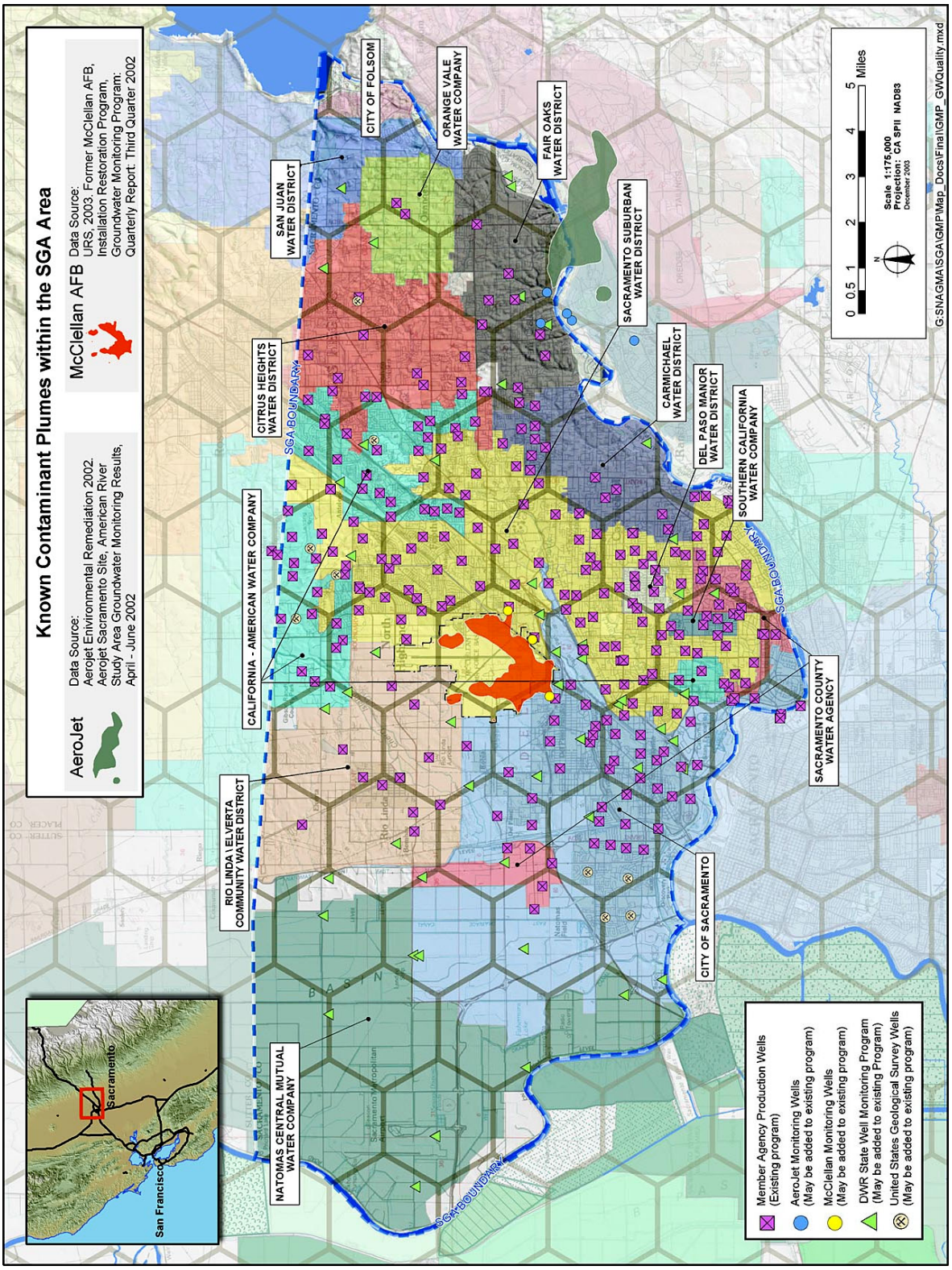

Figure 13. Existing and Proposed Wells in SGA Groundwater Quality Monitoring Network

While some land surface subsidence from compaction of water-bearing deposits caused by the removal of groundwater is known to have occurred west of the Sacramento River[16], the extent of subsidence east of the Sacramento River has been minimal. DWR maintains three subsidence monitoring stations in Sacramento Valley. The Sutter Station is located just north of the SGA area, where State Highway 99 crosses the Natomas Cross-Canal **(Figure 12)**. Total subsidence at the Sutter Station from spring 1995 to spring 2003 has been 0.026 feet (0.312 inch)[17]. Total subsidence at the Conaway Ranch Station, located west of the SGA area (**Figure 12**), from spring 1992 to spring 2003 has been 0.044 feet (0.526 inch)[18].

Historical benchmark elevation data for the period from 1912 through the late 1960s obtained from the National Geodetic Survey (NGS) were used to evaluate land subsidence in north Sacramento County. From 1947 to 1969 the magnitude of land subsidence measured at benchmarks north of the American River in Sacramento County ranged from 0.13 feet to 0.32 feet, with a general decrease in subsidence in a northeastward direction. This decrease is consistent with the geology of the area: formations along the eastern side of the Sacramento Valley are older than those on the western side and are subject to a greater degree of pre-consolidation making them less susceptible to subsidence. The maximum documented land subsidence of 0.32 feet was measured at both benchmark L846, located approximately two miles northeast of the former McClellan AFB, and benchmark G846, located approximately one mile northeast of the intersection of Greenback Lane and Elkhorn Boulevard.

Another land subsidence evaluation was performed in the Arden-Arcade area[19] of Sacramento County from 1981 to 1991. Elevations of nine wells in the Arden-Arcade area were surveyed in 1981, 1986, and 1991. The 1986 results were consistently higher than the 1981 results; this was attributed to extremely high rainfall totals in early 1986 that recharged the aquifer and caused a rise in actual land surface elevations. The 1991 results were consistently lower than the 1986 results; this was attributed to five years of drought immediately preceding the 1991 measurements, which caused depletion of the aquifer and resulting land surface subsidence. Comparison of eight[20] of the locations indicates that seven benchmarks have lower elevations in 1991 than in 1981 and one benchmark has a higher elevation in 1991. Of the seven benchmarks with lower elevations in 1991, the maximum difference is 0.073 feet (less than one inch). Whether this is inelastic subsidence is indeterminate from the data, but it is clear that the magnitude of the potential subsidence in the benchmarks during that period is negligible.

Actions. While available data and reports indicate that land surface subsidence is not a problem in the SGA area, the SGA is interested in pursuing additional possible actions to continue to monitor for potential land surface subsidence. These may include:

1. Investigate the feasibility and costs of re-surveying the wells in the Arden-Arcade area that were last measured in 1991.

[16] From 1988-1992 cumulative net sediment compaction of 0.78 feet was measured at the extensometer in Yolo County between June 15, 1988 and October 1, 1992 (USGS data from the Woodland land subsidence monitoring station, Yolo County, California, water years 1988-1992, USGS Open File Report 94-494)

[17] Based on information provided by Central District of DWR to MWH on 12/11/03.

[18] Based on information provided by Central District of DWR to MWH on 12/17/03.

[19] The boundaries of the Arden-Arcade area are (1) Sacramento's city limits on the west, (2) Sacramento's city limits and the American River on the south, (3) CWD on the east, and (4) Sacramento's city limits and Sac Suburban (Northridge Service Area) on the north.

[20] One of the nine wells could not be compared between 1981 and 1991 because the benchmark was destroyed and replaced between 1981 and 1986.

2. Coordinate with the USGS to ascertain the suitability of the use of Interferometric Synthetic Aperture Radar (InSAR) images of the SGA and surrounding area. If the technology appears suitable, identify the costs of determining ground surface elevations and identify potential cost-sharing partners.
3. Coordinate with other agencies, particularly the City and County of Sacramento and the NGS to determine if there are other suitable benchmark locations in the SGA area to aid in the analysis of potential land surface subsidence.
4. Educate SGA member agencies of the potential for land surface subsidence and signs that could be indicators of subsidence.

3.5.4 Surface Water Groundwater Interaction Monitoring

The interaction between groundwater and surface water has not been extensively evaluated within the SGA area. The SGA is currently aware of the following:

- A recent draft decision by the State Water Resources Control Board (SWRCB, 2003) regarding the American River, the SWRCB concluded that from Nimbus Dam to about 6,000 feet below the dam, groundwater elevations and surface water elevations were similar enough to each other that groundwater could be tributary to the American River. Beyond 6,000 feet down reach from Nimbus Dam, groundwater elevations are sufficiently lower than the river channel to conclude that the American River is a losing reach down to the confluence with the Sacramento River.
- Groundwater modeling (described in **Section 3.8.1**) has been used to estimate flow volumes between surface water and groundwater for various hydrologic conditions.
- CSUS in cooperation with DWR has recently installed several monitoring wells in and adjacent to the American River to investigate groundwater interaction with the American River and how recent USACE levee reinforcement projects might have changed the surface water-groundwater flow relationships.
- In 1991, Sacramento Regional County Sanitation District (SRCSD), Sacramento County, and Sacramento established the Sacramento Coordinated Water Quality Monitoring Program (CMP). Since that time, the CMP has monitored surface water quality for a variety of constituents including trace elements at several locations on the American River and Sacramento River. Within the SGA area, the CMP monitors the Sacramento River at the Interstate 5 Veteran Memorial Bridge, and the American River at Nimbus Dam and at Discovery Park.

Actions. The SGA will pursue actions to better understand the relationship between surface and groundwater in the SGA area, including:

1. Compile available stream gage data and information on tributary inflows and diversions from the American and Sacramento rivers to quantify net groundwater recharge or discharge between gages in the SGA area.
2. Coordinate with local, state, and federal agencies to identify available surface water quality data from the American and Sacramento rivers adjacent to the SGA area.
3. Correlate groundwater level data from wells in the vicinity of river stage data to further establish whether the river and water table are in direct hydraulic connection, and if the surface water is gaining or losing at those points.

4. Continue to coordinate with local, state, and federal agencies and develop partnerships to investigate cost-effective methods that could be applied to better understand surface water-groundwater interaction along the Sacramento and American rivers.
5. Coordinate with CSUS to analyze data obtained from recently constructed monitoring wells on the CSUS campus to better understand the relationship between the groundwater basin and surface water flows at that location.

3.5.5 Protocols for the Collection of Groundwater Data

The SGA has evaluated the accuracy and reliability of groundwater data collected by member agencies (MWH, 2002). The evaluation indicated a significant range of techniques, frequencies and documentation methods, for the collection of groundwater level and groundwater quality data. Although the groundwater data collection protocol may be adequate to meet the needs of the individual water districts, the lack of consistency between districts in the past yields an incomplete picture of basin-wide groundwater conditions. Other types of groundwater data collection protocols are included in **Sections 3.5.1** and **3.5.2** above.

Actions. To improve the comparability, reliability and accuracy of groundwater data, the SGA take the following actions:

1. Use a Standard Operating Procedure (SOP) for collection of water level data by each of the member agencies. **Appendix D** includes an SOP for Manual Water Level Measurements. This SOP was prepared using guidance documents available through USEPA and was included in the SGA technical memorandum summarizing the accuracy and reliability of groundwater data (MWH, 2002).

2. Provide member agencies with guidelines on the collection of water quality data developed by DHS for the collection, pretreatment, storage, and transportation of water samples (DHS, 1995).

3. Provide training on the implementation of these SOPs to member agencies, if requested.

3.5.6 Data Management System

The SGA membership includes 14 public agency and investor-owned water purveyors. Historically, the member agencies have maintained a varying range of groundwater-related data in a wide variety of formats. In order for the SGA to achieve its primary objective of sustaining the groundwater resource of the North Area Groundwater Basin, it was essential to develop a data storage and analysis tool, the DMS. The DMS was developed by MWH under contract with the USACE. Other local sponsors included DWR and the SGA.

Development of the DMS is a two-phase project. Phase I was completed in January 2003 and included initial development of the user interface and population of the DMS to a demonstration level of approximately one-fourth of the water purveyor wells. Phase II, to be completed by January 31, 2004, will fully populate the database and add further customization of the user interface with additional analysis features. Once the DMS is fully populated and quality-control checked a summary of existing basin conditions will be prepared. From this initial summary, analyses will be performed on at least an annual basis to assess the impacts of current and future SGA management actions on the groundwater system.

The DMS is a public domain application developed in a Microsoft Visual Basic environment and is linked to a SQL database of the SGA purveyor data. The DMS provides the end-user with ready access to both enter and retrieve data in either tabular or graphical formats. Security

features in the DMS allow for access restrictions based on a variety of user permission levels. Data in the DMS include:

- Well construction details.
- Known locations of groundwater contamination and potentially contaminating activities.
- Long-term monitoring data on:
    - Monthly extraction volumes.
    - Water elevations.
    - Water quality.
- Aquifer characteristics based on well completion reports.

The DMS allows for the viewing of regional trends in water level and water quality not previously available to the SGA (see **Figure 14** for a DMS screen capture). The DMS has the capability of quickly generating well hydrographs and groundwater elevation contour maps using historic groundwater level data. The DMS also has the ability to view water quality data for Title 22 required constituents as a temporal concentration graph at a single well or any constituent can be plotted with respect to concentration throughout the SGA area. Presentation of groundwater elevation data and groundwater quality data in these ways will be useful for making groundwater basin management decisions.

The SGA is currently in the process of establishing data transfer protocols so that groundwater data within the SGA area (by member agencies, DWR, AFRPA, USGS, etc…) can be readily appended to the database and analyzed through the DMS. Annual summaries of groundwater monitoring data will be prepared using the analysis tools in the DMS and presented in the update to the State of the Basin report (see **Section 4**).

Actions. To maintain and improve the usability of the DMS, the SGA will take the following actions:

1. Continue to update the DMS with current water purveyor data.
2. Make recommendations to the DMS developer on utilities to add to the DMS to increase its functionality.

3.6 COMPONENT CATEGORY 3: GROUNDWATER RESOURCE PROTECTION

The SGA considers groundwater protection to be one of the most critical components of ensuring a sustainable groundwater resource. In this GMP, resource protection includes both prevention of contamination from entering the groundwater basin and remediation of existing contamination. Prevention measures include proper well construction and destruction practices, development of wellhead protection measures, and protection of recharge areas. Containment and remediation include measures to prevent contamination from human activities as well as contamination from natural substances such as saline water bodies.

3.6.1 Well Construction Policies

The Sacramento County Environmental Management Department (EMD) administers the well permitting program for Sacramento County. The standards for construction are identified in Sacramento County Code No. SCC-1217 as amended on April 9, 2002. In addition to general well construction standards, Sacramento County has a policy of special review by appropriate regulatory agencies for well permits within 2,000 feet of a known contaminant plume (referred to

as Consultation Zones) and prohibits the drilling of new public supply wells at the former McClellan AFB. As part of the development of the DMS, the most recent extents of known contaminant plumes associated with the former McClellan AFB, the former Mather AFB, and Aerojet were delineated for the SGA.

Actions. The SGA will take the following actions:

1. Ensure that all member agencies are provided a copy of the county well ordinance and understand the proper well construction procedures.
2. Inform member agencies of Sacramento County's Consultation Zone and provide a copy of the boundary of the former McClellan AFB prohibition zone to appropriate member agencies.
3. Provide a copy of the most recently delineated plume extents at the former McClellan AFB, the former Mather AFB, and Aerojet to the EMD and SGA members for their review and possible use.
4. Coordinate with member agencies to provide guidance as appropriate on well construction. Where feasible and appropriate, this could include the use of subsurface geophysical tools prior to construction of the well to assist in well design.

3.6.2 Well Abandonment and Well Destruction Policies

The EMD administers the well destruction program for Sacramento County. The standards for construction are identified in Sacramento County Code No. SCC-1217 as amended on April 9, 2002. One concern expressed by the EMD[21] is that many abandoned domestic wells have not been properly destroyed. Historically, the north part of Sacramento County has been served by organized water districts, so there are not many privately owned domestic wells. As part of development of the DMS, DWR well records for all known wells in the basin were reviewed for reported abandonment and destruction. The wells were rated for the confidence of proper destruction based on the information provided on the report. This information was entered into the DMS. It is the SGA's opinion that the database as it currently stands, accurately reflects documented well destruction activities within the SGA area. The actions listed below will provide improved protection of groundwater quality within the SGA area.

Actions. The SGA will take the following actions:

1. Ensure that all member agencies are provided a copy of the code and understand the proper destruction procedures and support implementation of these procedures.
2. Follow up with member agencies on the reported abandoned and destroyed wells to confirm the information collected from DWR.
3. Provide a copy of the information on abandoned and destroyed wells in northern Sacramento County to fill any gaps in their records.
4. Meet with the EMD to discuss ways to ensure that wells in the SGA area are properly abandoned or destroyed.
5. Obtain "wildcat map from California Division of Oil and Gas to ascertain the extent of historic gas well drilling operations in the area as these wells could function as conduits of contamination if not properly destroyed.

[21] Faith King, pers. comm., August 11, 2003.

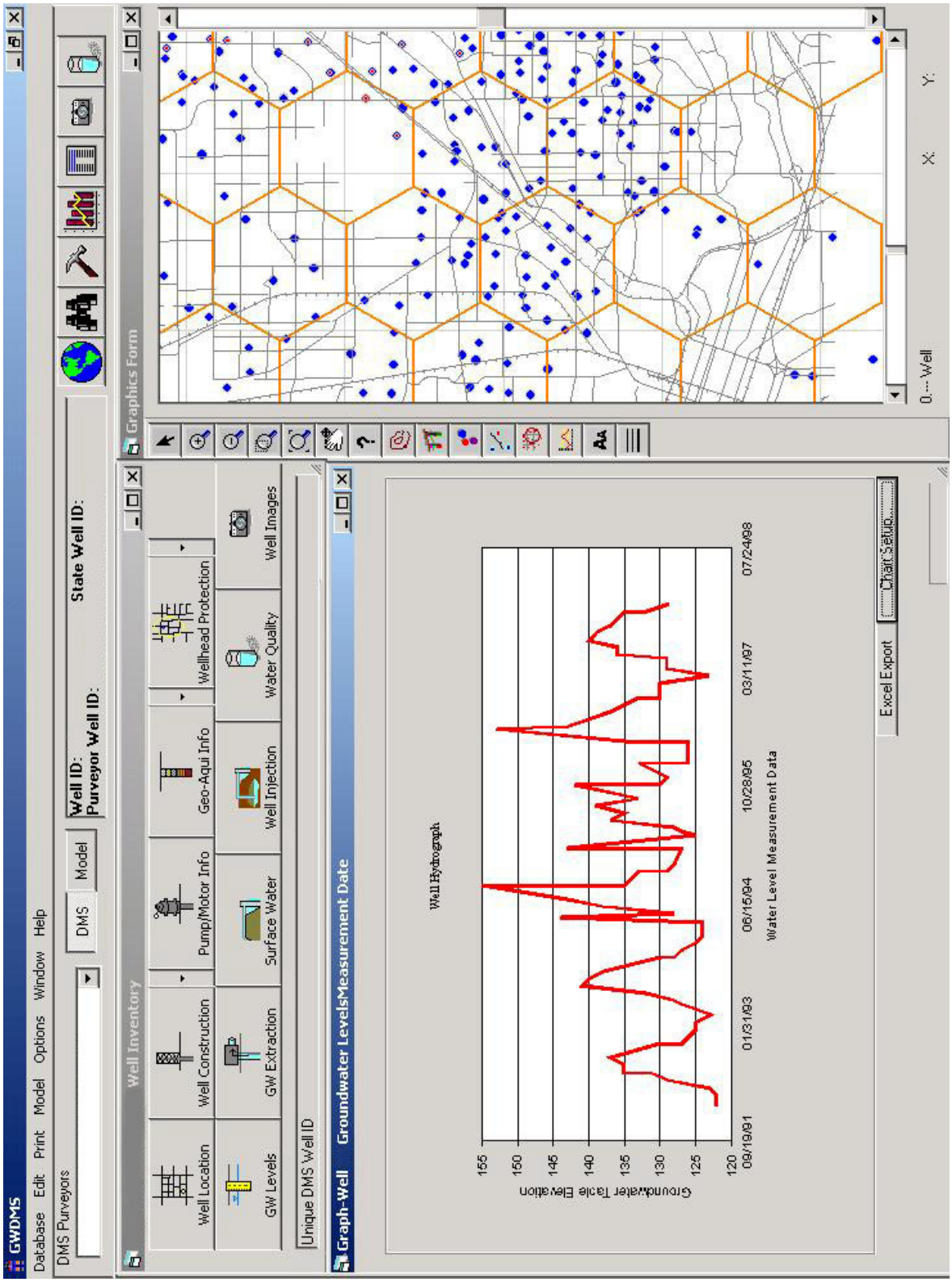

Figure 14. DMS Screen Capture

3.6.3 Wellhead Protection Measures

Identification of wellhead protection areas is a component of the Drinking Water Source Assessment and Protection (DWSAP) Program administered by DHS. DHS set a goal for all water systems statewide to complete Drinking Water Source Assessments by mid-2003. All SGA member agencies have completed their required assessments by performing the three major components required by DHS:

- Delineation of capture zones around sources (wells).
- Inventory of Potential Contaminating Activities (PCAs) within protection areas.
- Vulnerability analysis to identify the PCAs to which the source is most vulnerable.

Delineation of capture zones includes using groundwater gradient and hydraulic conductivity data to calculate the surface area overlying the portion of the aquifer that contributes water to a well within specified time-of-travel periods. Typically, areas are delineated representing 2-, 5-, and 10-year time-of-travel periods. These protection areas need to be managed to protect the drinking water supply from viral, microbial, and direct chemical contamination.

Inventories of PCAs include identifying potential origins of contamination to the drinking water source and protection areas. PCAs may consist of commercial, industrial, agricultural, and residential sites, or infrastructure sources such as utilities and roads. Depending on the type of source, each PCA is assigned a risk ranking, ranging from "very high" for such sources as gas stations, dry cleaners, and landfills, to "low" for such sources as schools, lakes, and non-irrigated cropland.

Vulnerability analysis includes determining the most significant threats to the quality of the water supply by evaluating PCAs in terms of risk rankings, proximity to wells, and Physical Barrier Effectiveness (PBE). PBE takes into account factors that could limit infiltration of contaminants including type of aquifer, aquifer material (for unconfined aquifers), pathways of contamination, static water conditions, hydraulic head (for confined aquifers), well operation, and well construction. The vulnerability analysis scoring system assigns point values for PCA risk rankings, PCA locations within wellhead protection areas, and well area PBE; the PCAs to which drinking water wells are most vulnerable are apparent once vulnerability scoring is complete.

The SGA has already added PCA and capture zone information from the DWSAP into the DMS. The DMS includes a feature that will automatically calculate wellhead protection areas if no data are available or if new well locations are proposed.

Actions. The SGA will take the following actions:

1. Request that member agencies provide vulnerability summaries from the DWSAP to the SGA to be used for guiding management decisions in the basin.
2. Contact groundwater basin managers in other areas of the state for technical advice, effective management practices, and "lessons learned," regarding establishing wellhead protection areas.

3.6.4 Protection of Recharge Areas

The SGA has also evaluated surface geology within and directly adjacent to its boundary for the purpose of delineating areas of potentially high recharge rates. Surface geology and estimates of relative recharge rates are shown on **Figure 15**. Much of the surface area considered to have the highest potential for recharge is already developed, so opportunities to ensure protection of these areas are somewhat limited.

Recently, most members of the SGA participated in the California Aquifer Susceptibility (CAS) Study administered by the SWRCB. Objectives of this study included sampling for many known contaminants at low detection levels to act as early indicators of potential problems particularly in recharge areas of aquifers. The results of this study are not yet available.

Actions. The SGA will take the following action:

1. When CAS results are available, meet with the SWRCB to discuss those results and consider follow-on actions.

3.6.5 Control of the Migration and Remediation of Contaminated Groundwater

The migration of contaminated groundwater in the SGA area is of primary concern from the McClellan AFB and Aerojet groundwater contamination plumes as shown in **Figure 4**. Also of concern is the localized contamination of groundwater by industrial point sources such as dry cleaning facilities and numerous fuel stations throughout the SGA area.

While the SGA does not have authority or the responsibility for remediation of this contamination, it is committed to coordinating with responsible parties and regulatory agencies to keep SGA members informed on the status of known contamination in the basin. For example, the SGA has requested and entered into its DMS a coverage of known LUSTs within the basin. This information is maintained by the SWRCB and CVRWQCB. Also, the SGA has been in communication with the AFRPA, which is overseeing remediation efforts at McClellan AFB (see **Section 3.4.2**).

Actions. The SGA will take the following actions:

1. Coordinate with known responsible parties to develop a network of monitoring wells to act as an early warning system for public supply wells.
2. If detections occur in these monitoring wells, facilitate meetings between the responsible parties and the potentially impacted member agency to develop strategies to minimize the further spread of contaminants. An example of a strategy would be to consider altering groundwater extraction patterns in the area to change to groundwater gradient.
3. Provide SGA members with all information on mapped contaminant plumes and LUST sites for their information in developing groundwater extraction patterns and in the siting of future production or monitoring wells.
4. Meet with representatives of the CVRWQCB to establish a mutual understanding about the SGA's groundwater management responsibilities. Identify ways to have open and expedient communication with CVRWQCB regarding any new occurrences of LUSTs, particularly when contamination is believed to have reached the water table.

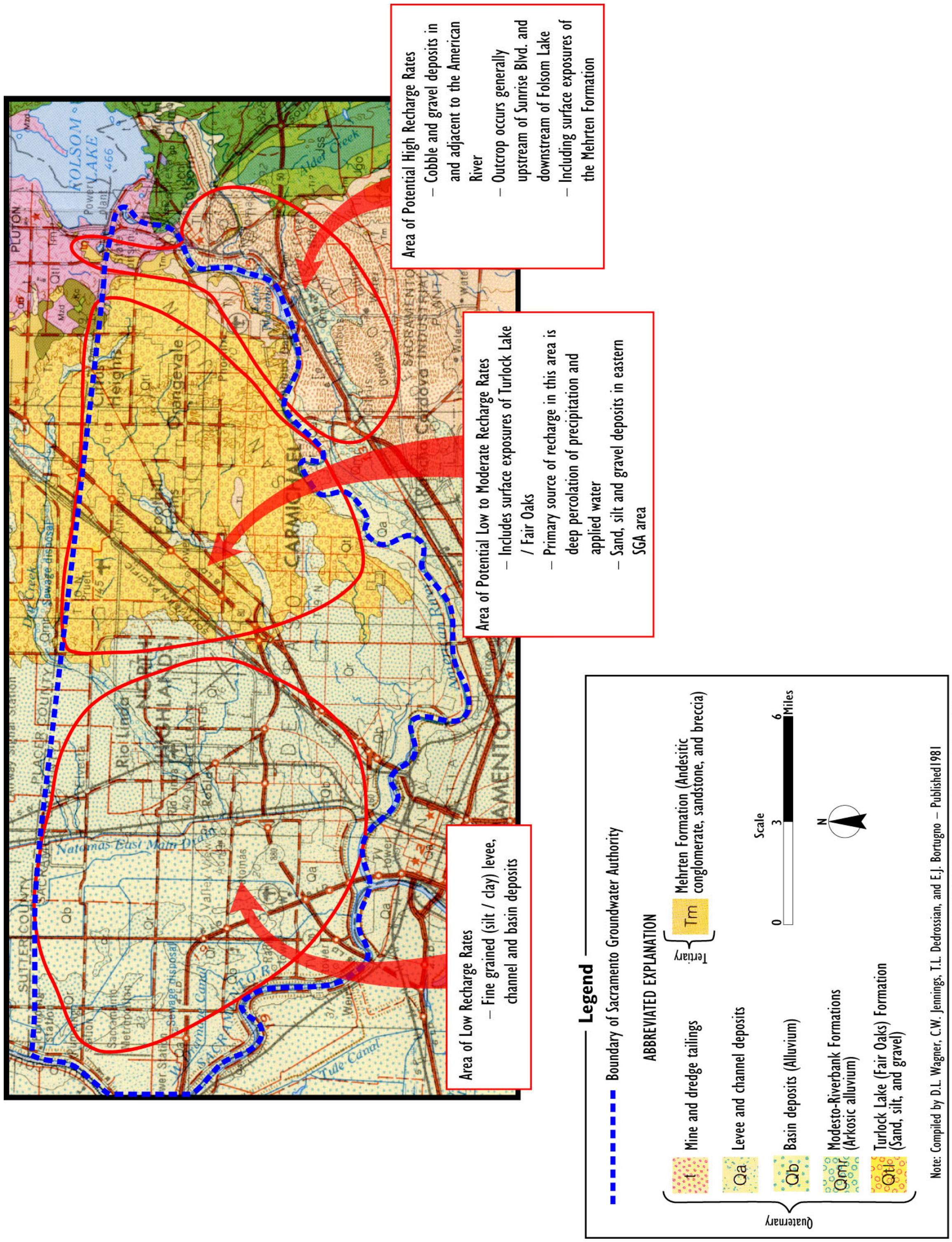

Figure 15. Surface Geology of the SGA Area – Implications for Surface Recharge Rates

3.6.6 Control of Saline Water Intrusion

Saline water intrusion from the Sacramento/San Joaquin River Delta (Delta) is not currently a problem in Sacramento County as a whole or in the North Area Groundwater Basin, and it is not expected to become a problem in the future. Higher groundwater elevations associated with recharge in the American and Sacramento rivers have maintained a historical positive gradient preventing significant migration of any saline water bodies associated with the Delta from migrating east into the Sacramento County region. These groundwater gradients will continue to serve to prevent any localized pumping depressions in the basin from inducing flow from the Delta into the North Area Groundwater Basin.

A more local source of saline water is beneath the base of fresh water in the North Area Groundwater Basin. Berkstresser (1973) mapped the base of fresh water (the point below which the specific conductivity of the water is greater than about 3,000 micromhos per centimeter (μmhos/cm)) for the Sacramento Valley. For the North Area Groundwater Basin, the minimum depth of fresh water is at an elevation of about 800 feet below mean sea level near the eastern basin margin and increases to a depth of approximately 2,000 feet below mean sea level on the western margin of the basin. The municipal suppliers in the North Area Groundwater Basin generally extract groundwater from depths of less than 500 feet, so their extractions are a substantially above the base of fresh water. Therefore, current pumping practices would not be expected to create a situation where deeper saline water is being drawn into the fresh water aquifer.

Actions. The SGA will take the following actions:

1. Track the progression, if any, of saline water bodies moving toward the east from the Delta. Because this is a highly unlikely scenario, this action will be limited to communicating with DWR's Central District Office on a biennial basis to check for significant changes to TDS concentrations in wells. DWR has a regular program of sampling water quality in select production wells throughout the adjacent Solano, San Joaquin, and Yolo counties. This will serve as an early warning system for the potential of saline water intrusion from the Delta.
2. Observe TDS concentrations in public supply wells of North Area Groundwater Basin water suppliers that are routinely sampled under the DHS Title 22 Program. These data will be readily available in the SGA's DMS and are already an on-going task for the annual review of basin conditions.
3. Inform all member water purveyor managers of the presence of the interface and the approximate depth of the interface below their service area for their reference when siting potential wells. The SGA will also ensure that the EMD, which issues well permits, is aware of the interface. The SGA will provide a map indicating the contour of the elevation of the base of fresh water in Sacramento County to the EMD for their reference when issuing well permits.

3.7 COMPONENT CATEGORY 4: GROUNDWATER SUSTAINABILITY

To ensure a long-term viable supply of groundwater, SGA members are seeking to maintain or increase the amount of groundwater stored in the basin over the long-term. The WFA's groundwater management element provides a framework by which the groundwater resource in the Sacramento County-wide area can be protected and used in a sustainable manner. It recommends an average annual sustainable groundwater yield within the SGA area of 131,000

AF/year. As documented in **Section 2** of the GMP, historic groundwater extractions have resulted in a net depletion of groundwater stored under the SGA area. To ensure a sustainable resource, SGA and RWA members have undertaken several actions toward increased conjunctive use of groundwater and surface in the basin and will continue to do so. Historically, water purveyors in the basin away from the rivers did not have access to surface water and a large cone of depression resulted in the middle of the SGA area. Recent conjunctive use activities have resulted in providing new surface water supplies to these areas. Although water purveyors in the region will rely more heavily on groundwater during dry periods, the net increase in available surface will result in a maintained or improved amount of groundwater in storage in the basin over the long term.

Two primary activities will result in an improved ability to sustain the viability of the groundwater resource for the region. Conjunctive management activities include the planning and construction of facilities to increase the available water supply to the area as well as to create opportunities for the banking and exchange of water with partners after local needs are met. These partnerships will result in some of the necessary capital improvements to help sustain the resource in a cost-effective way. Additionally, the SGA's ability to sustain the groundwater resource will be met in part through reductions in potable water demand through conservation measures and through the use of recycled water for landscape irrigation supply. These groundwater sustainability activities are discussed below.

3.7.1 Conjunctive Management Activities

The SGA and RWA members are committed to expanded conjunctive use operations and are investigating a variety of ways of recharging water into the available storage space in the basin. Opportunities for direct recharge from overlying land in the basin are limited, because much of the land is developed or is overlain by flood basin deposits. Most of the recharge occurring through current conjunctive use is from in-lieu recharge. One component of the RWA ARBCUP (see below) is an aquifer storage and recovery well, which will inject water just north of the basin. Current and potential future facilities in the basin are further described in the Cooperating Agencies RWMP Phase II Final Report (MWH, 2003).

Cooperating Agencies RWMP. As discussed in **Section 2.5**, Phase I of the RWMP identified and described a "menu" of project and program alternatives for implementing the WFA north of the American River. Phase II provided detailed hydrologic, engineering, and legal/institutional evaluations of those projects and programs that best aligned with the goals and objectives of the individual water purveyors and the WFA. The recommendations resulting from Phase II were used to structure the SGA and RWA's regional projects and programs.

Sac Suburban's Groundwater Stabilization Project. This project allows groundwater elevations underlying the SGA area to increase naturally (in-lieu recharge) by providing up to 29,000 AF of surface water per year to an area that has historically relied on groundwater. From 1998 through 2001, Sac Suburban utilized an annual average of about 12,850 AF of surface water, reducing its use of groundwater and resulting in stabilization of groundwater elevations that had been declining historically at a rate of about 1.5 feet per year (LSCE, 2002). This project is a prime example of the types of activities to be included in a conjunctive use program envisioned in the WFA.

RWA ARBCUP. The objective of the RWA ARBCUP is to implement elements of the regional conjunctive use program developed in the Cooperating Agencies RWMP. Through the RWA ARBCUP, treated surface water will be delivered to areas that have historically used

groundwater in wet years, resulting in in-lieu recharge. In dry years, the stored water will be recovered in areas that have historically used surface water, allowing forbearance of surface water diversions.

The RWA ARBCUP will provide an additional average water supply yield in the region of 21,400 AF/year. Projects such as these strongly support the goal and objectives of the SGA's GMP. The project consists of 12 program components (see **Table 5** and **Figure 7**) constructed by seven public agencies. Facilities include an expansion of surface water treatment plant capacity, water transmission system improvements (including pipelines, a pump station, and an aboveground water storage tank for flow equalization), groundwater extraction wells, and meter replacements. In 2001, the RWA submitted a grant application to DWR for a groundwater storage construction grant and was subsequently awarded $21.67 million. The RWA member agencies are matching the grant with local funds to construct the project.

SGA-SAFCA Pilot Study. In 1999/2000, a pilot study was conducted with SAFCA and Reclamation as a means of exercising the groundwater storage potential resulting form the regional cone of depression and investigating the mechanics of a large-scale conjunctive use program. In this pilot study, an on-call surface water supply was provided to SAFCA. Specifically, SAFCA diverted and stored (banked) 2,100 AF of water in the basin. The following year, surface water in the amount of 1,995 AF was made available by exchange through the extraction of groundwater in-lieu of diverting a CVP supply from Folsom Reservoir. SAFCA used this water on an as-needed basis to satisfy its refill obligations associated with flood management reservation in Folsom Reservoir.

EWA Pilot Study. In 2002, the SGA conducted an expanded pilot study. It entered into an agreement with Reclamation (on behalf of the EWA) for the one-year sale of up to 10,000 AF of surface water. A portion of this surface water (up to 5,000 AF) was made available in Folsom Reservoir through a transfer of a portion of SJWD's CVP contract entitlement. The other 5,000 AF was made available by Sacramento through forbearance of a surface water diversion right on the lower American River. In both cases, local demand was met by recovery of previously banked groundwater.

Actions. The SGA will take the following actions:

1. Continue to investigate conjunctive use opportunities within the SGA area. The SGA and its members will coordinate with the RWA and its members, as appropriate.
2. Continue to investigate opportunities for the development of direct recharge facilities in addition to in-lieu recharge (e.g. injection wells or surface spreading facilities, through constructed recharge basins or in river or streambeds).

3.7.2 Demand Reduction

Another way to stay within the sustainable yield of the basin and continue to achieve in-lieu recharge is by reducing demand on potable water supplies through conservation and by making recycled water available for irrigation of landscaping.

Water Conservation. The RWA has developed and implemented a regional Water Efficiency Program (WEP). The WEP assists members to meet their water conservation agreements with the Water Forum, the California Urban Water Conservation Council, and for some members the Central Valley Project Improvement Act (CVPIA). The water conserved as part of this effort is essential to the Water Forum's ability to meet its objectives of providing a safe, reliable water supply to 2030 and protecting the lower American River in two ways. First,

the conserved water will serve to meet increased future demands. Second, the conserved water will reduce the overall demand on the groundwater basin in drier years and can reduce the demand for water diverted from the lower American River. The goal of the WFA is to achieve system-wide conservation of slightly more than 25 percent by the year 2030.

SGA members have also implemented other conservation measures outside of the WFA. One example is in NCMWC's tailwater recovery system implemented in 1986. The program achieves conservation through the reapplication of water that runs off of agricultural fields within the NCMWC system. The system also results in reduced runoff of agricultural applied water to the Sacramento River thereby decreasing agricultural pesticides that would have been in the river.

Water Recycling. SRCSD treats wastewater for the Sacramento region at its Elk Grove Wastewater Treatment Plant and is looking for ways to increase the delivery of recycled from the plant to landscape irrigation uses. SRCSD joined the RWA as an associate member in September 2003. By joining the RWA, SRCSD can work closely with other member agencies to investigate opportunities to use recycled water throughout the area to more effectively develop the regional water supply. Currently, SRCSD is recycling 5 mgd at its Elk Grove facility and delivering it to nearby landscape irrigation users. SRCSD expects the capacity of that facility to increase to 10 mgd over the next few years. Currently, recycled water is only delivered to users south of the SGA area. SRCSD is investigating ways to deliver recycled water north of the American River in the future.

Actions. The SGA will take the following actions:

1. Coordinate with the RWA and its members that have signed specific agreements to the WFA to ensure that those conservation efforts are on track. For members that are not signatory, the SGA will ensure that they are informed of the benefits and regional importance of RWA's WEP.
2. Coordinate with SRCSD through the RWA to investigate opportunities for expanded use of recycled water throughout the county.

3.8 COMPONENT CATEGORY 5: PLANNING INTEGRATION

With the large number of autonomous water agencies and companies serving the greater Sacramento area, the need to integrate water management planning on a regional scale is a high priority and was one of the key reasons that the RWA and SGA organizations were formed. Individual members derive their supplies from the American River, the Sacramento River, the North Area Groundwater Basin, or some mix of these sources. Individual agency infrastructure systems are mostly independent; where interconnections do exist between agencies, they are typically for emergency purposes only.

The WFA provides a regional conjunctive use framework with commitments from individual agencies concerning groundwater and surface water operations, including limitations on surface water diversions from the lower American River during dry years. The SGA and RWA planning efforts seek to better integrate the individual plans of member agencies to implement various elements of the WFA in keeping with the 2030 regional framework. Such integration also promotes operational efficiency, cost savings, and in some cases generates larger statewide-system benefits. For example, the 2002 SGA partnership with Reclamation to provide water to the EWA involved integrating plans and operational actions of five SGA member agencies to produce over 7,000 AF of water in Folsom Reservoir for EWA purposes. The SGA provided the institutional and contractual mechanisms to ensure that individual agencies implemented the

operational changes necessary to produce the water and to ensure that the quality and yield of the groundwater basin was protected.

The RWA, which is better positioned to facilitate integrated planning because of its greater geographic extent (Sacramento, Placer, and El Dorado counties), is actively implementing the ARBCUP and plans to implement the follow-on program to the Cooperating Agencies RWMP. In addition, the RWA has implemented a regional WEP, a program to coordinate the development of agency drinking water source assessment and protection documents, and is actively coordinating with regional land use planning agencies regarding the availability of future water supplies to support planned growth.

3.8.1 Existing Integrated Planning Efforts

The SGA and RWA have already demonstrated implementation of integrated management in the region. Some of the integrated planning efforts to date are listed below.

Water Efficiency Program. Described in **Section 3.7.2**

Banking and Exchange. Described in **Section 3.4.4**

Urban Water Management Planning. Twelve SGA members are required to prepare Urban Water Management Plans. These plans, as defined by CWC § 10610 *et seq.*, require public water suppliers with more than 3,000 customers or that deliver more than 3,000 AF of water annually to identify conservation and efficient water use practices to help ensure a long-term, reliable water supply. To date, all 12 members have submitted plans to DWR. Ten of the plans have been approved by DWR. One additional plan has been resubmitted and is under review by DWR. One plan is currently being amended by the member agency.

Regional Sanitation. Described in **Section 3.7.2**

DWSAP Program. The DWSAP Program is administered by DHS. As a first step to a complete source protection program, DHS required water systems to conduct a preliminary assessment. The assessment includes:

> "delineation of the area around a drinking water source through which contaminants might move and reach that drinking water supply; an inventory of possible contaminating activities (PCAs) that might lead to the release of microbiological or chemical contaminants within the delineated area; and a determination of the PCAs to which the drinking water source is most vulnerable (http://www.dhs.ca.gov/ps/ddwem/dwsap/overview.htm)."

The assessments only apply to agencies that deliver groundwater for public drinking supply. All of the 11 SGA member agencies required to submit assessments have done so. Data from the assessments have been incorporated into the SGA's DMS.

Land Use Planning. In March 2002, the Water Forum Successor Effort approved a set of procedures for coordinating land use decision-making with water resources planning. As signatories to the WFA, the SGA members are committed to following the procedures outlined in **Appendix E**. In addition, the SGA will assist members in complying with these procedures. Through the RWA, better coordination and communication have been initiated with the Sacramento Area Council of Governments (SACOG) regarding meeting the water supply needs of future planned growth.

Integrated Surface Water and Groundwater Modeling. The SGA is interested in using and building upon existing groundwater models for the SGA area. In the late 1990s, a range of groundwater extraction and recharge scenarios were simulated using the North American River

and Sacramento County Combined Integrated Groundwater and Surface Water Model (IGSM[22]). This model was originally developed for the American River Water Resources Investigation (ARWRI) conducted by Reclamation and later updated by the Cooperating Agencies for their RWMP effort (see **Appendix F**).

The original version of IGSM used for the study originated from the ARWRI version of the model used for the "Draft Water Forum Solution Model" developed for the Water Forum. The purpose of the Water Forum was development of a conjunctive use strategy for the groundwater basin underlying northern Sacramento County and southern Placer County.

The SGA is interested in maintaining and updating the IGSM because it is the basis for the WFA and the Cooperating Agencies RWMP alternative analyses, and because it is the model used for regional planning by Reclamation and DWR for projects such as the ARWRI, the CVPIA, and the CALFED process.

The SGA recently completed a study in cooperation with DWR that focused on updating the Calibration Model. The objectives of this effort were to convert the existing IGSM input files to run in the most current version of IGSM (version 6.0). Historical water budgets from 1969 to 1995 were developed and a comparison of model results with actual measured values for groundwater elevations and streamflows over the calibration period were provided. The SGA is pursuing having the calibration period extended from 1995 to 2000.

Actions. The SGA will take the following actions:

1. Prepare and adopt a formal integrated water management plan in accordance with CWC § 10540 *et seq.* The plan will include, but not be limited to, the elements listed above. The SGA will form an ad hoc committee with the RWA to determine which agency would be most appropriate to prepare that plan.
2. Review the Water Forum Land Use procedures and make recommendations on what additional role, if any, the SGA should take with respect to land use decisions within the SGA area.

[22] The IGSM is a finite element, quasi three-dimensional, multi-layered model that integrates surface water and groundwater on a monthly time step. The IGSM was developed for use as a regional planning tool for large areas influenced by both surface water and groundwater. The tool is well-equipped to accommodate input and output of land use and water use data over large areas. Data input includes hydrogeologic parameters, land use, water demand, precipitation and other hydrologic parameters, boundary inflows, and historical water supply. For purposes of parameter definition and developing water budgets around physical and/or political boundaries, the IGSM divides Sacramento, Placer, Sutter, and San Joaquin counties into subregions. Each subregion is further divided into unique numbered elements varying from 200 to 800 acres in size. Overlying this grid is a coarse parametric grid utilized for specifying aquifer and other parameters.

4 PLAN IMPLEMENTATION

Table 6 summarizes the action items presented in **Section 3** and an implementation schedule. Many of these actions involve coordination by the SGA with other local, state and federal agencies and most of these will begin within 6 months, following adoption of this GMP. A few activities involve assessing trends in basin monitoring data for the purpose of determining the adequacy of the monitoring network. These assessments will be made as new monitoring data become available for review by the SGA, and results will be documented in an annual State of the Basin report (see below).

4.1 ANNUAL GMP IMPLEMENTATION REPORT

The SGA will report on progress made implementing the GMP in an annual State of the Basin report, which will summarize groundwater conditions in the SGA area and document groundwater management activities from the previous year. This report will include:

- Summary of monitoring results, including a discussion of historical trends.
- Summary of management actions during the period covered by the report.
- A discussion, supported by monitoring results, of whether management actions are achieving progress in meeting BMOs.
- Summary of any plan component changes, including addition or modification of BMOs, during the period covered by the report.

The State of the Basin report will be completed by April 1st each year and will report on conditions and activities completed through December 31st of the prior year.

4.2 FUTURE REVIEW OF GMP

This GMP is intended to be a framework for the first regionally-coordinated management efforts in the SGA area. As such, many of the identified actions will likely evolve as the SGA actively manages and learns more about the basin. Many additional actions will also be identified in the annual summary report described above. The GMP is therefore intended to be a living document, and it will be important to evaluate all of the actions and objectives over time to determine how well they are meeting the overall goal of the plan. The SGA plans to evaluate this entire plan within five years of adoption.

4.3 FINANCING

It is envisioned that implementation of the GMP, as well as many other groundwater management-related activities will be funded from a variety of sources including the SGA; in-kind services by member agencies; state or federal grant programs; and local, state, and federal partnerships. Some of the items that would likely require additional resources include:

- Monitoring for groundwater quality or elevations in non-purveyor wells.
- Customization of the DMS interface.
- Preparation of GMP annual reports.
- Updates of the overall GMP.
- Update of data sets and recalibration/improvement of existing groundwater model.

- Collection of additional subsidence data.
- Construction of monitoring wells where critical data gaps exist.
- Stream-aquifer interaction studies.
- Implementation of the GMP including:
    - Committee coordination.
    - Project management.
- Implementation of regional conjunctive use program.

During year one of plan implementation, an estimate of some of the likely costs associated with the above activities will be prepared.

Table 6. Summary of GMP Actions

Description of Action	Implementation Schedule (approximate time for commencing activity following adoption of GMP)
I. COMPONENT CATEGORY 1: STAKEHOLDER INVOLVEMENT	
Involving the Public	
1 Continue efforts to encourage public participation as opportunities arise.	on-going
2 Review and take actions from the public outreach plan as necessary during implementation of various aspects of the GMP.	on-going
3 Provide briefings to the Water Forum Successor Effort on GMP implementation progress.	on-going
4 Work with members to maximize outreach on GMP activities including the use of the SGA Web site, member Web sites, or bill inserts.	12 months
Involving Other Agencies Within and Adjacent to the SGA Area	
1 Continue high level of involvement demonstrated through the SGA GMP development into implementation of the plan by continued participation on committees described above.	on-going
2 Provide copies of the adopted GMP and subsequent annual reports to representatives from Placer, Sutter, and Yolo counties, and the Groundwater Forum.	3 months
3 Meet with representatives from Placer, Sutter, and Yolo counties, and the Groundwater Forum as needed.	6 months
4 Coordinate a meeting with the agricultural groundwater pumpers in the SGA area to inform them of SGA's management responsibilities and activities, and develop and develop a list of agricultural groundwater pumpers concerns and needs relative to SGA's management of the area.	6 months
5 Coordinate a meeting with other self-supplied pumpers in the SGA area to inform them of SGA's management responsibilities and activities, and develop a list of self-supplied groundwater pumpers concerns and needs relative to SGA's management of the area.	6 months
Utilizing Advisory Committees	
1 Upon adoption of the GMP, the Policy Committee will meet to discuss the continuation and composition of committees to guide implementation of the plan.	3 months
Developing Relationships with State and Federal Agencies	
1 Continue to develop working relationships with local, state, and federal regulatory agencies.	on-going
Pursuing Partnership Opportunities	
1 Continue to promote partnerships that achieve both local supply reliability and achieve broader regional and statewide benefits.	on-going
2 Continue to track grant opportunities to fund groundwater management activities and local water infrastructure projects.	on-going
II. COMPONENT CATEGORY 2: MONITORING PROGRAM	
Groundwater Elevation Monitoring	
1 Coordinate with member agencies and DWR to identify an appropriate group of wells for monitoring for a spring 2004 set of groundwater elevation measurements.	3 months
2 Coordinate with DWR and SCWA to ensure that the selected wells are maintained as part of a long-term monitoring network.	3 months
3 Coordinate with DWR and SCWA to ensure that the timing of water level data collection by member agencies coincides within one month of DWR and SCWA data collection.	3 months
4 Coordinate with member agencies to ensure that needed water level elevations are collected and verify that uniform data collection protocols are used among the agencies.	3 months
5 Coordinate with the USGS to determine the potential for integrating USGS monitoring wells constructed for the National Water Quality Assessment (NAWQA) Program into the SGA monitoring network.	3 months
6 Consider ways to fill gaps in the monitoring well network by identifying additional suitable existing wells or identifying opportunities for constructing new monitoring wells.	3 months
7 Assess groundwater elevation trends and conditions based on the network annually.	Results and recommendations included in State of Basin report published in April of each year
8 Assess the adequacy of the groundwater elevation monitoring well network annually.	Results and recommendations included in State of Basin report published in April of each year
9 Identify a subset of monitoring wells that will be monitored more frequently than twice annually to improve the SGA's understanding of aquifer responses to pumping throughout the year.	12 months

Table 6. Summary of GMP Actions (continued)

	Description of Action	Implementation Schedule (approximate time for commencing activity following adoption of GMP)
	Groundwater Quality Monitoring	
1	Coordinate with member agencies to verify that uniform protocols are used when collecting water quality data.	6 months
2	Coordinate with the USGS to obtain historic water quality data for NAWQA wells, determine timing and frequency of monitoring under USGS program, and to discuss the potential for integrating USGS monitoring resources with the SGA network.	6 months
3	Coordinate with member agencies and other local, state, and federal agencies to identify where wells may exist in areas with sparse groundwater quality data.	6 months
4	Assess the adequacy of the groundwater quality monitoring well network annually.	Results and recommendations included in State of Basin report published in April of each year
	Land Surface Elevation Monitoring	
1	Investigate the feasibility and costs of re-surveying the wells in the Arden-Arcade area that were last measured in 1991.	12 months
2	Coordinate with the USGS to ascertain the suitability of the use of Interferometric Synthetic Aperture Radar (InSAR) images of the SGA and surrounding area. If the technology appears suitable, identify the costs of determining ground surface elevations and identify potential cost-sharing partners.	12 months
3	Coordinate with other agencies, particularly the City and County of Sacramento and the National Geodetic Survey to determine if there are other suitable benchmark locations in the SGA area to aid in the analysis of potential land surface subsidence.	12 months
4	Educate SGA member agencies of the potential for land surface subsidence and signs that could be indicators of subsidence.	12 months
	Surface Water Groundwater Interaction Monitoring	
1	Compile available stream gage data and information on tributary inflows and diversions from the American and Sacramento rivers to quantify net groundwater recharge or discharge between gages in the SGA area.	12 months
2	Coordinate with local, state, and federal agencies to identify available surface water quality data from the American and Sacramento Rivers adjacent to the SGA area.	12 months
3	Correlate groundwater level data from wells in the vicinity of river stage data to further establish whether the river and water table are in direct hydraulic connection, and if the surface water is gaining or losing at those points.	12 months
4	Continue to coordinate with local, state, and federal agencies and develop partnerships to investigate cost-effective methods that could be applied to better understand surface water-groundwater interaction along the Sacramento River and American River.	12 months
5	Coordinate with CSUS to analyze data obtained from recently constructed monitoring wells on the CSUS campus to better understand the relationship between the groundwater basin and surface water flows at that location.	6 months
	Protocols for the Collection of Groundwater Data	
1	Use a Standard Operating Procedure (SOP) for collection of water level data by each of the member agencies.	3 months
2	Provide member agencies with guidelines on the collection of water quality data developed by DHS for the collection, pretreatment, storage, and transportation of water samples (DHS, 1995).	3 months
3	3. Provide training on the implementation of these SOPs to member agencies, if requested.	3 months
	Data Management System	
	No Action Required	
III.	**COMPONENT CATEGORY 3: GROUNDWATER RESOURCE PROTECTION**	
	Well Construction Policies	
1	Ensure that all member agencies are provided a copy of the county well ordinance and understand the proper well construction procedures	3 months
2	Inform member agencies of Sacramento County's Consultation Zone and provide a copy of the boundary of the former McClellan AFB prohibition zone to appropriate member agencies.	6 months
3	Provide a copy of the most recently delineated plume extents at the former McClellan AFB, the former Mather AFB, and Aerojet to the EMD and SGA members for their review and possible use.	3 months
4	Coordinate with member agencies to provide guidance as appropriate on well construction. Where feasible and appropriate, this could include the use of subsurface geophysical tools prior to construction of the well to assist in well design.	3 months

Table 6. Summary of GMP Actions (continued)

	Description of Action	Implementation Schedule (approximate time for commencing activity following adoption of GMP)
	Well Abandonment and Well Destruction Policies	
1	Ensure that all member agencies are provided a copy of the code and understand the proper destruction procedures and support implementation of these procedures	3 months
2	Follow up with member agencies on the reported abandoned and destroyed wells to confirm the information collected from DWR	6 months
3	Provide a copy of the information on abandoned and destroyed wells in northern Sacramento County to fill any gaps in their records	12 months
4	Meet with the EMD to discuss ways to ensure that wells in the SGA area are properly abandoned or destroyed	6 months
5	Obtain "wildcat map from California Division of Oil and Gas to ascertain the extent of historic gas well drilling operations in the area as these wells could function as conduits of contamination if not properly destroyed.	12 months
	Wellhead Protection Measures	
1	Request that member agencies provide vulnerability summaries from the DWSAP to the SGA to be used for guiding management decisions in the basin.	6 months
2	Contact groundwater basin managers in other areas of the state for technical advice, effective management practices, and "lessons learned," regarding establishing wellhead protection areas	12 months
	Protection of Recharge Areas	
1	When CAS results are available, meet with the SWRCB to discuss those results and consider follow-on actions	6 months
	Control of the Migration and Remediation of Contaminated Groundwater	
1	Coordinate with known responsible parties to develop a network of monitoring wells to act as an early warning system for public supply wells.	6 months
2	If detections occur in these monitoring wells, work with the responsible parties and the potentially impacted member agency to develop strategies to minimize the further spread of contaminants.	on-going
3	Provide SGA members with all information on mapped contaminant plumes and LUST sites for their information in developing groundwater extraction patterns and in the siting of future production or monitoring wells	6 months
4	Meet with representatives of the RWQCB to establish a mutual understanding about SGA's groundwater management responsibilities	6 months
	Control of Saline Water Intrusion	
1	Track the progression, if any, of saline water bodies moving toward the east from the Delta.	on-going
2	Observe TDS concentrations in public supply wells of North Area Groundwater Basin water suppliers that are routinely sampled under the DHS Title 22 Program. These data will be readily available in the SGA's DMS and are already an on-going task for the annual review of basin conditions.	on-going
3	Inform all member water purveyor managers of the presence of the interface and the approximate depth of the interface below their service area for their reference when siting potential wells.	on-going
VI.	**COMPONENT CATEGORY 4: GROUNDWATER SUSTAINABILITY**	
	Conjunctive Management Activities	
1	Continue to investigate conjunctive use opportunities within the SGA area	on-going
2	Continue to investigate opportunities for the development of direct recharge facilities in addition to in-lieu recharge (e.g. injection wells or surface spreading facilities, through constructed recharge basins or in river or stream beds).	on-going
	Demand Reduction	
1	Coordinate with the RWA and its members that have signed specific agreements to the WFA to ensure that those conservation efforts are on track. For members that are not signatory, the SGA will ensure that they are informed of the benefits and regional importance of RWA's WEP.	on-going
2	Coordinate with SRCSD through the RWA to investigate opportunities for expanded use of recycled water throughout the county.	on-going
V.	**COMPONENT CATEGORY 5: PLANNING INTEGRATION**	
	Existing Integrated Planning Efforts	
1	Prepare and adopt a formal integrated water management plan in accordance with CWC Section 10540 et seq. The SGA will form an ad hoc committee with the RWA to determine which agency would be most appropriate to prepare that plan.	12 months
2	Review the Water Forum Land Use procedures and make recommendations on what additional role, if any, SGA should take with respect to land use decisions within the SGA area	6 months

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